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COMPARATIVE STUDY OF WEED CONTROL METHODS IN RICE

by

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Weeds copmpete with rice for light, nutrients, water, and space. They reduce yields and lower the market value of the crop by reducing its quality, if they are not controlled adequately. The annual losses to the rice crop from competition with weeds are estimated to amount 23 percent of the total farm value of the rice crop or 73 million dollars in the United States.

Methods of weed control have been roughly classified into three groups, namely: (1) ecological control method; (2) mechanical control method, and (3) chemical control method (Matsubayashi, 1963). In Taiwan, hand weeding has been the traditional and standard method of weed control. In recent years, however, interest in chemical weed control has intensified with the introduction of new herbicides on the market and some of them have already been evaluated for control of weeds in rice (Chang, 1961; Young, 1962). The use of herbicides already has gained wide acceptance among farmers in the United States and Japan since the herbicide, 24-D, was first used for selective weed control in early 1944 (Price and Klingman, 1958). Surveys indicated that in 1959 farmers used more than 100 million pounds of herbicides on approximately 50 million acres of agricultural land at an estimated cost of 150 million dollars in the United States (Shaw and Danielson, 1961). Smith *et al.* (1959) reported that 40-60% of United States rice crop is being sprayed each year with 2, 4-D, MCPA or closely related herbicides.

In wet season, 1964 the International Rice Research Institute initiated a research program to evaluate new chemicals and chemical combinations for weed control in rice at Chiayi, Taiwan and other rice growing tropical countries, in cooperation with Chiayi Agricultural Experiment Station and other Asian Rice Research Institutions. The purpose of this paper is to present a brief summary of the significant results obtained at this Station.

MATERIALS AND METHODS

The experiment was conducted on the second crop (wet season) of 1964 at Chiayi Agricultural Experiment Station Farm, Chiayi, Taiwan. The paddy field is of clay loam soil with pH value, organic matter, and available phosphorus content ranging from 5.3 to 5.6, 1.60 to 1.75%, and 40 to 65 kilograms per hectare, respec-

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tively. Chianung 242, a leading commercial variety developed at this Staton, was used in this experiment.

A total of 15 treatments were arranged in randomized complete blocks with four replications. A 12 m^2 plot (3×4 m) was treated in each case and a 10 m^2 plot (2.5×4 m) was used as the unit for yield sampling. From each plot, two small subplots (20×50 cm) were randomly selected for weed counts and cover estimates. Levees were made arround the plots to prevent the interflow of herbicides between treatments.

Before transplanting, 1.50 kg per hectare of *Echinochloa* spp., 0.25 kg per hectare of *Monochoria vaginalis*, and 1.00 kg per hectare of *Fimbristylis* spp. and *Cyperus* spp. seeds were broadcast in order to insure a uniform and dense stand of weeds.

Herbicides were applied either by spraying or by broadcasting. The herbicides were sprayed by using a portable 1.5-liter hand sprayer. Approximately one liter of solution was sprayed for each plot to assure uniform and complete coverage of all plants. In case of dry applications, herbicides were thoroughly mixed with suitable amonnt of fine burned soils and broadcast evenly over a plot. The plots were drained before application of herbicides and they were flooded again one to two days after the application. The herbicides and rates of application are given in Table 1.

The experimental [plots were transplanted in July 25, 1964 and harvested in November 4, 1964. The distance between rows was 25 cm and that between hills within a row was 20 cm. Approximately five seedlings were planted in each hill. The amount of fertilizer used was 80, 40, and 40 kg per hectare for N, P, and K respectively. All of P, K, and half of N were used as a basal dressing one day before transplanting and the balance of N used as a top-dressing at 20 days after transplanting. Insecticide, Sevin, was sprayed at 45, 65, and 80 days after transplanting for the control of rice stem borer. Fungicide, Tuzet, was sprayed at 80 days after transplanting to control sheath blight of rice. Special attention was paid to avoid applying insecticides within 10 days of herbicides treatment.

Weather conditions during the period of treatment were rather cloudy. Tropical shower visited almost every afternoon in August and in early September. Typhoon did not hit Taiwan directly, but they did bring heavy rains to the island. The climatic data for the period of herbicides treatment are presented in Table 2.

Data on weed counts, weed coverage, rice toxicity and dry weed weight were taken. Weed counts and weed coverage estimates were made twice, namely one day before treatment and 10 days after treatment based on the pre-set subplots. Weed control was graded three times, namely one day before, 10 days, and 40 days after treatment while rice toxicity was recorded 2 days, and 40 days after treatment, both grading were reported in percentage in comparison with weeded and non-weeded plots. Dry weed weight per plot was measured one week before harvesting.

Heading date, plant height, number of tillers, number of panicles, number of grains, panicle length, and 1,000-grain weight were recorded for each plot. Yield

Table 1. Herbicides used in tests

Treatment Code No.	Herbicides: Common name	Herbicides: Chemical name	Formulation Concentration	Active rate (kg/ha)	Time and method of application
1	PCP-Na	Pentachlorophenol	88% flake+soil	15	Sprayed 7.5 kg at 3 days+7.5 kg at 20 days after transplanting.
2	Propanil	3,4-dichloro-propionanilide	36% e.c.	3.5	Sprayed at 14 days after transplanting.
3	Propanil+MCPA	—	36+40% e.c.	3.5+0.8	Sprayed at 14 days after transplanting.
4	MCPA	2-methyl-4-chlorophenoxy-acetic acid	40% e.c.	0.8	Sprayed at 25 days after transplanting.
5	Propanil+2,4-D	—	36% e.c.+80% WP	3.5+0.8	Sprayed at 14 days after transplanting.
6	2,4-P (Na)	2,4-dichlorophenoxyacetic acid	80% WP	0.8	Sprayed at 25 days after transplanting.
7	Swep	3,4-dichlorocarbamilate	80% WP	5	Sprayed at 14 days after transplanting.
8	Swep+MCPA	—	80% WP+40% e.c.	4+0.5	Sprayed at 14 days after transplanting.
9	Simetryne	2,4-bis (ethylamino)-6-methylmerocapto-s-triazine	50% WP	0.5	Broadcast with soil at 10 days after transplanting.
10	Ametryne	2-methylmercapto-4-ethylamino-6-isopropylamino-s-triazine	50% WP	0.5	Broadcast with soil at 10 days after transplanting.
11	Hydram	Ethyl-l-hexamethyl-ineimine carbothiolate	72% e.c.	5.0	Sprayed at 14 days after transplanting.
12	MCPCA	2-methyl-4-chlorophenoxy-aceto-orthochloroaniline	2.5% G	3.0	Broadcast at 10 days after transplanting.
13	DBN	2,6-dichlorobenzoinitrile	50% WP	2.0	Sprayed at 10 days after transplanting.
14	Weedy Check	—	—	—	none.
15	Weeded Check	—	—	—	Handweeded to maintain weed-free condition.

Table 2. Climatic data of the Station during the period of hebicides treatment

Five-day Period	Rainfall amount (mm)	Number of rainy days	Number of sunshine (hours)	Mean relative humidity (%)	Temperature (°C)		
					Minimum	Maximum	Mean
July. 28– Aug. 1	3.5	1	19.9	66.2	24.1	32.5	28.4
Aug. 2– 6	16.7	3	12.1	65.6	24.4	32.8	28.6
Aug. 7–11	35.6	3	8.6	66.0	25.0	32.5	28.7
Aug. 12–16	71.5	4	12.8	71.8	23.4	32.4	27.9
Aug. 17–21	104.6	5	23.2	68.6	24.4	32.1	28.3
Aug. 22–26	88.5	3	22.9	69.6	24.4	32.4	28.4
Aug. 27–31	118.0	5	24.8	72.6	23.5	31.7	27.6
Sept. 1– 5	57.4	3	22.4	70.6	24.7	32.0	28.3
Sept. 6–10	57.9	4	29.2	70.6	24.6	32.4	28.5

of clean paddy rice at 14 percent moisture content was also taken for each treatment from each replication. The data thus collected were subjected to analysis of variance and means were compared by Duncan's multiple range test. Square root, and logarithmic transformations were made for the data of weed counts, and weed weight respectively, before making the analysis. For the data of cover estimates, weed control, and toxicity to rice, the arcsin transformation was made.

RESULTS AND DISCUSSION

The Infestation of Weeds.

The infestation of weeds in the experimental plots as expressed by weed counts and cover estimates made before the application of chemicals are given in Table 3.

Table 3 presented a general picture of weed infestation in the experimental plots before the application of herbicides. Although differences among treatments were quite large in each of the three weed classes in both measurements, the results did indicate that broadleaves predominated over the other two, grasses and sedges in the experimental plots. The broadleaves were mostly aquatic, namely, *Lemma pancicostata*, *Spirerdera polyrhiza* and *Masilea quadrifolia*, while *Monochoria vaginalis* and other broadleaves constituted only a small fraction of this group. The grasses included *Echinochloa* spp., *Leptochloa chinensis* and *Paspalum scrobiculatum*, the latter being mostly the remnants of the previous crop. *Cyperus iria*, *Fimbristylis miliaceae* and *Kyllingia brevifolia* were the predominant sedges of the experimental plots. It should be pointed out here that the plots continuously flooded with deep water since transplanting and the germination of weed seeds broadcasted before transplanting was rather poor. As a result of continuous flooding, the surface of plots were mostly covered with broadleaved aquatics, as indicated in Table 3. However, changes in weed populations did occur after these measurements especially in grasses and sedges which increased both in numbers and coverage.

Table 3. Weed counts and cover estimates based on $0.1\ m^2$ subplots

Code No.	Treatment	Weed counts				Cover estimates (%)			
		Grasses	Broad-leaves	sedges	Total	Grasses	Broad-leaves	sedges	Total
1	PCP-Na	1.2	126.2	0.7	128.1	2.4	49.0	0.3	51.7
2	Propanil	3.7	197.3	18.1	219.1	5.0	56.2	7.0	68.2
3	Propanil+MCPA	1.1	194.7	10.7	206.5	2.8	70.0	2.5	75.3
4	MCPA	4.2	323.0	22.9	350.1	4.8	78.2	9.6	92.6
5	Propanil+2,4-D	7.4	200.4	9.5	217.3	8.4	60.4	2.6	71.4
6	2,4-D	6.1	385.5	14.6	406.2	5.9	87.4	5.2	98.5
7	Swep	2.1	196.4	8.1	206.6	1.5	65.0	3.9	70.4
8	Swep+MCPA	1.6	150.0	15.6	167.2	2.4	44.1	8.6	55.1
9	Simetryne	1.1	162.6	3.0	166.7	0.3	45.9	1.9	48.1
10	Ametryne	3.3	125.1	20.9	149.3	3.1	37.9	6.4	47.4
11	Hydram	0.4	319.8	9.2	329.4	0.9	86.8	2.1	89.8
12	MCPCA	0.7	164.6	5.6	170.9	0.3	38.8	1.2	40.3
13	DBN	3.9	177.0	4.1	185.0	1.5	44.0	2.2	47.7
14	Weedy Check	3.6	231.3	8.6	243.5	0.2	59.5	4.4	64.1
15	Weeded Check	0.5	114.8	6.3	121.6	0.5	39.6	1.7	41.8
	Mean	2.7	204.6	10.5	217.8	2.7	57.5	4.0	64.2
	F value	1.06	1.52	1.47	1.92	1.47	3.03**	1.31	5.31**
	LSD 1%	—	—	—	—	—	15.4	—	15.6

** F value significant at 1% level.

The Evaluation of Weed Control.

Several methods were used to measure weed control and its effect on rice plant for each treatment and the results obtained are summarized in Table 4.

From weed counts and cover estimates, it was revealed that good weed controls were obtained in the treatments of Ametryne, Simetryne, PCP-Na, Swep+MCPA and DBN, while Hydram, 2, 4-D and MCPA gave poor control of weeds. Since the plots were occupied mostly by broadleaved aquatics at the early stage of growth of rice plants, the treatments which could kill these aquatics eventually resulted in good weed controls. An efficient control of aquatic broadleaves by PCP, even at a low concentration (0.1%) was also reported by Yui and Yamamoto (1955). The differences among three classes of weeds, compared separately or in total, were highly significant in both measurements among different treatments, except for grasses in weed counts and sedges in cover estimates, where they failed to reach the level of significance.

Weed control estimates were, in general, consistent with the previous two measurements, weed counts and cover estimates. Ametryne and Simetryne gave nearly 80 percent weed control of weeded check, while PCP-Na, Swep+MCPA and DBN resulted in about 60 perecent weed control, An average of 60% weed control by PCP was also reported by Yui and Yamamoto (1955). MCPCA and Hydram

Table 4. Effects of herbicides on weeds and rice plants

Code No.	Treatment	Weed counts (0.1 m²)				Cover estimates (% in 0.1 m²)				Weed control (%)				Toxicity to rice plant (%)	Dry weed weight (g/plot)			
		Grasses	Broad-leaves	Sedges	Total	Grasses	Broad-leaves	Sedges	Total	Grasses	Broad-leaves	Sedges	Average		Grasses	Broad-leaves	Sedges	Total
1	PCP-Na	2.2	19.3	1.8	23.3	7.3	13.8	0.4	21.5	37.3	52.1	82.0	57.0	19.9	990.0	188.0	0.5	1178.5
2	Propanil	2.5	212.2	3.5	218.2	3.6	57.7	2.4	63.7	33.9	36.7	63.7	44.3	0.3	763.7	110.5	7.8	882.1
3	Propanil+ MCPA	0	247.7	0.4	248.1	0	65.4	0	65.4	49.1	51.7	77.9	58.6	0.3	268.8	79.3	2.0	350.1
4	MCPA	4.6	560.7	0.5	565.8	13.7	78.8	0.2	92.7	32.2	52.8	75.9	52.1	12.2	717.5	77.5	0	795.0
5	Propanil+ 2,4-D	3.2	219.2	1.6	224.0	4.4	54.9	0.7	60.0	40.5	49.9	74.3	54.3	1.3	866.3	77.8	2.3	946.4
6	2,4-D	3.2	800.5	4.1	807.8	7.6	89.9	1.3	98.8	32.7	47.2	72.3	49.6	7.7	1043.8	52.8	0.3	1096.9
7	Swep	3.0	95.2	6.2	104.4	2.8	31.2	2.4	36.4	36.1	52.0	79.2	56.1	1.5	681.3	35.8	1.8	718.9
8	Swep+MCPA	3.0	21.6	3.0	27.6	2.6	6.3	0.7	9.6	42.5	69.8	84.4	65.3	0.3	855.0	43.3	0.5	898.8
9	Simetryne	1.9	0.4	1.3	3.6	0.7	0.1	0.6	1.4	60.7	83.6	90.8	78.3	13.6	473.8	44.5	2.5	520.8
10	Ametryne	2.0	0.2	0	2.2	0.5	0	0	0.5	59.9	81.6	95.3	79.1	48.6	1092.5	320.8	9.5	1422.8
11	Hydram	0.4	683.4	3.4	687.2	0.5	97.3	1.3	99.1	68.5	37.1	79.6	59.2	2.9	151.3	39.8	0.3	191.4
12	MCPCA	4.6	202.9	0.7	208.2	5.7	44.0	0.1	49.8	51.8	55.1	81.7	62.3	12.0	650.0	89.8	1.5	741.3
13	DBN	3.5	98.2	0	101.7	2.0	27.2	0	29.2	45.8	52.2	76.4	58.1	12.8	741.3	74.3	1.0	816.6
14	Weedy check	1.6	445.9	9.2	456.7	1.6	92.7	2.6	96.9	0	0	0	0	0	1132.3	165.0	101.8	1399.1
15	Weeded check	0	0	0	0	0	0	0	0	100	100	100	100	0	9.8	4.8	1.0	15.6
	Mean	2.4	240.4	2.4	245.2	3.5	44.0	0.9	48.4	46.1	54.8	75.6	58.3	8.8	695.2	93.6	8.2	798.3
	F value	1.19	10.21**	2.07*	10.18**	2.57**	12,57**	1.73	13.20**	25.88**	60.91**	13.96**	35.87**	21.70**	9.29**	3.09**	5.09**	9.31**
	L.S.D. 5%	—	66.9	0.72	64.4	3.6	13.9	—	16.4	3.1	1.4	6.4	2.2	1.7	3.5	5.0	3.7	3.1
	L.S.D. 1%	—	120.7	—	116.1	6.4	24.0	—	28.1	5.6	2.4	11.2	4.0	3.0	5.3	8.6	5.7	4.5

* F value significant at 5 % level.
** F value singificant at 1 % level.

which were poor weed killers when measured by weed counts and cover estimates, appeared to have substantial control of weeds by the weed control ratings. Since floating broadleaves constituted most of the weed populations of experimental plots, the results clearly indicated that good weed control of MCPCA and Hydram could de attributable to more effective control of both grasses and sedges.

2, 4-D and MCPA gave poor control of weed which was in consistent with the two previous measurements. The poor weed control of 2, 4-D and MCPA was due partly to the ineffectiveness of these two chemicals to kill floating broadleaves and partly to the fact that grasses were too large at the time of treatment to permit a complete kill. A similar result was also reported by Smith (1960). Young (1962) found in his experiment that aquatic broadleave weed, *Masilea quadrifolia*, was not killed by 2, 4-D, even though complete kill of *Monochoria vaginalis* was observed. The similar situation also prevailed in this experiment. In general, MCPA controlled weeds better than 2, 4-D.

It is of particular interest to note that Propanil appeared to be the poorest weed killers of all herbicides tried in this experiment. Smith (1961) reported that good control of barnyardgrass was obtained by applying Propanil in the first- to third leaf stages of growth. Experiments conducted by a number of local experiment stations generally came up to the results similar to that of Smith (1961). The results of The International Rice Research Institute (1963) revealed that Propanil gave good control of broadleaves and sedges. However, Propanil was also found to be unable to control one of the aquatic broadleave weeds, *Marsilea quadrifolia*, and some grasses of *Leptochloa* and *Paspalum* species, especially old remnants of them (Chang, 1961). Since Propanil was applied at the proper stage of growth, i. e. 2 to 3 leaf stage, and special attention was also paid for the water managemant, the poor performance of Propanil in this experiment appeared to be due largely to the poor control of this chemical on most of aquatic weeds and some grasses, the weeds unfortunately were the major problem. The chemical was sprayed with a sprayer without a pressure regurator, and it was doubtful that a good coverage was ever attained. Propanil is a contact herbicide and good coverage is a prerequisite to good weed control. Therefore, poor weed control witnessed in this experiment for Propanil may also be related to the incomplete contact of the chemical.

Differnces of weed control among treatments were highly significant in three classes of weeds and in average.

Phytotoxicity of herbicides to rice plants was manifested in several ways and some of them were qualitative in nature and difficult to be expressed quantitatively. Ametryne, PCP, Simetryne, and DBN, which were among the best weed killers, happened to be also the most toxic herbicides to rice plants. The injury of these chemicals was manifested by burning of the rice seedlings. Among them, Ametryne appeared to be the most toxic one and the leaf burn caused by this chemical ultimately ended in complete kill of rice plants. As a result, the stand of rice was reduced greatly. However, the injury caused by the other three did not result in

death and it was found to recover within 7 to 10 days. The phytotoxicity of MCPCA and 2,4-D was manifested mostly in qualitative manner, such as stunting growth, yellowish leaves and reduction of tillers. Very slight or even no toxicity was detected for Propanil, Swep, and Hydram, as already observed on Propanil by Smith (1961) and on Swep by Hudgins (1964). The difference in phytotoxicity to rice greatly exceeded the 1% level of probability.

So far, no different response of rice varieties to the toxicity of herbicides ever tried was detected and rice varieties were found to respond similarly to 2,4-D (Smith, 1958). However, different varietal response to herbicides was observed in other small grain crops. Price and Klingman (1958) reported that wheat and oat varieties responded differently to varying treatments of 2,4-D. Hodgson *et al.* (1964) also detected differential response of certain barley and wheat varieties to seven herbicides namely, 2,4-D, MCPA, Dicanba, Barban, G 3436, Propanil and DMPA. Resistance to an agricultural chemical in barley was found by Wiebe and Hayes (1960) to be genetically controlled by a single major recessive gene. Since some of best weed killers in this experiment were very toxic to rice plants, it is reasonable to suppose that a much better job could be done if the rice varieties were genetically resistant to the herbicides applied. At the same time, solutions for the reduction of phytotoxicity can also be approached from further tests in formulation of herbicides, active rate applied per unit area, time of application, and many others.

The measurment of dry weed weight indicated that grasses gave the majority of the final product of weeds, while broadleaves and sedges comprised only small portions of it. The data reflected a change in the importance of weed infestation, from broadleaves in the early stage to the grasses at the late stage of rice growth. It was observed that aquatic weeds often died when rice was approaching maturing stage, while grasses, especially barnyardgrass which was so inconspicuous at the early stage of rice, grew vigorously with the growth of rice and they eventually dominated the weed population at late tillering stage of rice and provided severe competition for rice. As a result, herbicides which gave good control on grasses, such as Hydram and Simetryne resulted in light weight of dried weeds. Ametryne actually gave good weed control on all classes of weeds, but it also reduced the stand of rice which provided an open space for the growth of weeds, especially grasses and *Monochoria vaginalis*. Conseqnently, Ametryne produced higher yield of weeds in both grasses and broadleaves. PCP, the second heavy producer of weeds, also gave good control of weeds at the first application but some weeds, which were not completed killed, eventually recovered and were too large to be killed at the second application. Since weed competiton with rice was reported to be most serious during the first 30 days after emergence of weeds (Show and Danielson, 1961), the increase in rice yield treated with PCP may be attributable to the good weed control obtained at the first application. 2,4-D, Porpanil and MCPA which gave poor weed control by the other measurements, also produced higher

yields of weeds. It should be noted, however, that weedy check produced as much weeds as Ametryne and weeded check left only a trace of weeds. The differences in dry weight of weeds were significant at 1% level of probability.

Among methods used in this experiment for evaluation of weed control, only the measurement of dry weed weight is free from artificial errors associated with investigators. Therefore, it may present the most accurate information on the effect of herbicides. However, it should take into account the change of weed population during the whole period of rice growth if weed control of herbicides is to be evaluated correctly. The other measurements are more or less arbitrary and subject to variabilities associated with time of rating and individual investigators involved. In this experiment, it was tried to minimize the variability of these measurements as much as possible.

Effects of Herbicides on Some Agronomic Characters of Rice.

In order to know to what extent rice plants are affected by herbicides, some important agronomic characters were measured. A summary of the data and F values computed on these characters are presented in Table 5.

It was indicated that Ametryne significantly delayed the date of heading. The

Table 5. Effects of herbicides on some agronomic characters of rice plants

Code No.	Treatment	Heading date (days)	Plant height		Number of tillers per hill	Panicle	
			40 days (cm)	Full ripe (cm)		weight (g)	length (cm)
1	PCP-Na	58	87.1	111.8	9.7	4.5	23.9
2	Propanil	57	91.1	113.2	10.0	4.3	25.2
3	Propanil+MCPA	57	89.2	113.6	8.7	4.9	25.1
4	MCPA	56	81.5	115.5	8.1	4.8	25.1
5	Propanil+2,4-D	58	91.2	115.2	9.3	4.8	25.1
6	2,4-D	57	84.0	114.5	9.0	4.8	25.3
7	Swep	57	95.6	117.7	10.9	4.5	25.1
8	Swep+MCPA	57	91.5	117.0	10.6	4.9	24.7
9	Simetryne	57	88.9	113.9	9.7	5.4	25.2
10	Ametryne	60	84.9	111.1	9.7	5.4	24.9
11	Hydram	58	91.5	112.9	9.9	4.5	24.8
12	MCPCA	58	85.2	114.7	7.4	5.2	25.3
13	DBN	58	88.2	112.2	9.5	4.3	24.6
14	Weedy check	56	94.3	113.0	9.4	4.3	24.6
15	Weeded Chcck	58	93.0	114.5	10.9	4.4	24.7
	Mean	57	89.2	114.1	9.5	4.7	24.9
	F value	3.67**	7.27**	1.48	4.33**	2.25*	0.98
	L.S.D. 5%	1.2	4.3	—	1.3	0.7	—
	L.S.D. 1%	1.6	5.7	—	1.8	—	—

* Difference significant at the 5% level.
** Difference significant at the 1% level.

severe injury caused by this chemical apparently inhibited the early growth of rice and eventually resulted in later maturity. The plots heavily infested with weeds such as those of weedy check, MCPA and 2,4-D, headed significantly earlier than others, indicating that keen competition with weeds could hasten the maturity of rice.

Plant height measured at 40 days after transplanting were highly significant among treatments, reflecting the influence of phytotoxicity of herbicides. When the plant height was again measured at maturity, no significant difference was evident, showing that the injury had fully recovered.

Phytotoxicity of herbicides was also manifested in the reduction of tillers. As indicated by the result, MCPCA produced least tillers, suggesting that tillering ability of rice was severely inhibited by this particular chemical. The vegetative growth of weeds treated with MCPCA was also observed to be poor, indicating that good weed control of MCPCA may be due primarily to its suppressive effect on the growth of weeds. In general, weeds infestation reduced the number of tillers. The difference in number of tillers per hill was significant at 1% level of probability.

Rice plants with less tillers as in the plots of MCPCA generally produced heavier panicle. The difference in panicle weight was significant at the 5% level of probability. Panicle length was not significantly affected by the treatments.

Effects of Herbicides on Grain Yield and Components of Yields.

Since the ultimate interest of conducting a herbicide experiment is to find out the effect of herbicides on the actual yield of rice, the data on grain yield and its components were taken. The results are given in Table 6.

Growing conditions during the whole period of growth were good and insect pests as well as diseases were also well under control. The grain yield of weeded check was typical for Chianung 242 obtained at Chiayi area on this crop season. DBN produced the highest yield while Ametryne the lowest. The difference in yield among treatments greatly exceeded the 1% level of significance. Although grain yield was not significantly different from weeded check except for weedy check and Ametryne, the increase of yield by several herbicides or mixtures of herbicides was quite great. DBN increased 563 kg per hectare or 12.0% when compared with weeded check. When compared with weedy check, DBN produced 1,320 kg per hectare or 33.6% more grain yield, a difference greatly exceeding the 1% level of probability. Non-weeded check reduced 757 kg per hectare or 19.3% of grain yield in comparison with weeded check, which was weeded by hands as commonly practiced by farmers in Taiwan. The degree of reduction in yield caused by weed competition was lower than 37.5% as reported by Shaw and Danielson (1961), but it was quite similar to the average estimated loss of 20-40% in Japan and 14% in the United states.

From the analysis of yield components, it was revealed that both number of

Table 6. Effects of herbicides on grain yield

Code No.	Treatment	Grain yield (kg/ha)	Components of yield		
			Number of panicles per hill	Number of grains per panicle	Weight of 1,000 grains (g)
1	PCP-Na	4,828 a-b***	8.2	162.8	30.4
2	Propanil	4.435 b-d	9.0	151.3	29.7
3	Propanil+MCPA	4,322 b-d	8.3	181.7	28.9
4	MCPA	4,665 a-c	7.8	162.8	30.0
5	Propanil+2,4-D	4,658 a-c	8.2	177.1	29.3
6	2,4-D	4,215 b-d	8.3	170.4	28.6
7	Swep	4,775 a-b	8.5	163.9	30.0
8	Swep+MCPA	4,694 a-b	9.0	179.7	30.5
9	Simetryne	4,739 a-b	8.5	188.0	29.5
10	Ametryne	3,849 d	8.4	192.4	30.3
11	Hydram	4,701 a-b	9.3	158.9	30.0
12	MCPCA	4,920 a-b	7.1	192.5	29.8
13	DBN	5,253 a	9.2	163.9	29.2
14	Weedy check	3,933 c-d	8.6	153.3	30.0
15	Weeded check	4,690 a-b	9.0	161.3	28.5
	Mean	4,578	8.5	170.7	29.6
	F valne	3.94**	2.48*	4.06**	1.24
L.S.D.	5%	734	1.05	19.37	—
	1%	983	—	25.92	—

* Difference significant at the 5% level.

** Difference significant at the 1% level.

*** Letters with a dash between are inclusive for the range, grain yields with letters in common are not significantly different from each other at the 5% level.

panicles per hill and number of grains per panicle were significantly affected by the treatments of herbicides and weed competition while weight of 1,000 grains was not significantly affected. Apparently either number of panicles or number of grains, had contributed to the increase of yields. The reduction in number of panicles was not so serious as that of number of grains in weedy check, indicating that the latter was more sensitive to weed competition than the former. It was also indicated that low yield in the plots treated with Ametryne may be attributable primarily to the reduction of rice stand, since yield components gave more than the average values.

The treatmets of DBN, MCPCA, PCP-Na, Swep, Simetryne and Hydram showed a strong trend toward yield increase, suggesting that adequate weed control may be available with these chemicals. A substantial increase in yield by DBN and vigorous growth of rice plants during the early growing stage treated with Swep indicating a stimulatory effect from these chemicals. If the phytotoxicity of PCP-Na, Simetryne and Ametryne can be reduced by readjusting time of application, reducing active rate to be used, applied in granules or by other means, these

chemicals may appear promising as paddy herbicides. However, these results are based on only one season's testing and more thorough testing is necessary.

Propanil which has been intensively studied in Taiwan and elsewhere, may find its application quite difficult in the second crop of rice when monsoon climate prevails, since it requires at least 8 to 12 hours after treatment for the absorption by weeds. Furthermore, at certain places where facilities for good irrigation and drainage are not available, water management will also be a problem for Propanil. The spraying of insecticides will become more or less inflexible by the application of propanil.

Under present conditions, more herbicides in granular formulation should be tried in Taiwan, since granules can be easily spread by hands and do not require an expensive spraying equipment. At the same time, the phytotoxicity of herbicides to rice can also be reduced. It is also commonly known that several species of weeds, varying in susceptibility to herbicides, are usually grown in paddy field. It is, therefore, suggested that more mixtures of herbicides which differ in their effectiveness in controlling various weed spectrums, should be evaluated.

It was also shown that the tillage which has been an important standard cultural practice of rice in Taiwan, did not contribute greatly, as generally regarded it would be, to the vegetative growth and grain yield of rice, indicating that this time consuming and laborious practice may be unnecessary, as long as paddy fields are maintained free from weeds.

Time-to-weed was estimated to be about 10 minutes per plot per hand weeding for weeded check under the conditions of this experiment. It is equivalent to about 133 man-hours or 17 work-days per hectare. Based on this measurement, a total of 399 man-hours or 50 work-days will be needed with an estimated cost of NT$1,000 or US$25 per hectare if good control is to be obtained by hands. Meanwhile, current price figures indicate that the costs of commercially available herbicides are estimated to range from NT$64 or US$1.6 per hectare for MCPA and 2, 4-D, NT$600 or US$15 per hectare for PCP to NT$1,120 or US$28 per hectare for Propanil with methods of application indicated in this experiment. Chemical weed control is, therefore, not necessarily expensive nor impractical. At the present time, a solution of weed problems seems to be best approached by substituting one or two hand weedings by one application of certain herbicides. In view of the rapid progress in industrial development and possible reduction in the price of herbicides, it is believed that the future prospect for chemical weed control to become an integral practice of rice culture in Taiwan seems bright.

SUMMARY

Field investigation was made on the second crop (wet season) of 1964 at Chiayi Agricultural Experiment Station to evaluate the effectiveness of 13 herbicides and herbicide mixturers together with weedy and weeded checks for controlling weeds

in rice. A total of 15 treatments were arranged in randomized complete blocks with four replications. The effects of herbicide treatments on rice were evaluated by weed counts, cover estimates, weed control ratings, phytotoxicity estimates, weed weight, agronomic eharacters and grain yield. Some findings of this investigation may be summarized as follows:

Ametryne and Simetryne gave best control of weeds, particularly of aquatic floating broadleaves which were apparently not killed by other chemicals. When weeds, especially grasses were rather large at time of treatment, they were not controlled by PCP-Na, MCPA and 2, 4-D. Propanil gave poor control of weeds under the conditions of this experiment.

Rice was injured severely by Ametryne, PCP-Na and Simetryne. MCPCA was also found to have certain inhibitory effects on the growth of rice. Propanil and Swep were not toxic to rice under flooded condition.

Broadleaved weeds, especially those of aquatics dominated the weed population of the experimental plots at the early stage of rice growth, but their position was apparently taken over by grasses at the late stage. The change in weed population was clearly reflected in weed weight which was primarily contributed by grasses. Sedges were not an important problem.

Weeds hastened the heading of rice while chemical injury delayed it. Plant height and tillering ability of rice was significantly reduced at the early stage of growth. Panicle length and grain weight were not affected by herbicide treatments but weeds seemed to reduce number of grains per panicle.

DBN, MCPCA, PCP-Na, Swep, Simetryne, Hydram and a mixture of Swep+ MCPA produced more grain yields than weeded check. DBN yielded 563 kg or 12.0% more than weeded check and 1,320 kg or 33.6% more than weedy check, the latter being significant at 1% level. Weedy check reduced grain yield by 757 kg or 19.3%, a difference exceeding the 5% level of probability, when compared with weeded check, indicating a serious loss of yield by weed competition. Ametryne gave the lowest yield due to the reduction of stands caused by its toxicity to rice.

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幾種水田新殺草劑之治草效果

張　萬　來

摘　　要

嘉義農業試驗分所與國際稻米研究所合作，於民國53年第二期作舉辦水田殺草劑治草試驗，應用十三種不同配合之殺草劑，從事水田治草效果觀察，玆將初步所得結果，簡述於後：

Ametryne 與 Simetryne 殺草效果最佳，尤對紫背浮萍，青萍及田字草等水生濶葉雜草，具有特效。惟一般殺草劑對大株雜草效果較差，Propanil 在本試驗之治草效果最差。

Ametryne，PCP 與 Simetryne 對水稻毒害較强，MCPCA 有抑制水稻發育現象，僅 Propanil 和 Swep 對水稻未有毒害作用。

水稻生育初期，稻田雜草大都爲水生濶葉草，中、後期則以稗草類之雜草爲最多，水生濶葉草在水稻生育後期逐漸自滅，故收穫前所得雜草乾重以稗草所佔比例最大，而三稜葱草，鴨舌草及水蜈蚣等所佔比例較少。

雜草叢生可促進水稻抽穗，但對每穗粒數似有減少之趨勢，水稻受殺草劑强性毒害則延遲抽穗。殺草劑可抑制水稻生育早期之株高及分蘖，但不影響穗長，千粒重。

DBN, MCPCA, PCP, Swep, Simetryne, Hydram 以及 Swep+MCPA 處理區稻谷產量超過慣行除草區。DBN 處理區每公頃產量較慣行除草區多出563公斤（12%）比不除草區高1,320公斤（34%），後者差異達 1% 顯著值，不除草處理比慣行除草者減產757公斤達 19%，其差異遠超5%顯著水準，由此概見水田雜草爲害，使稻谷減產之一斑。Ametryne 因具有强性毒害，致使部份水稻被害，呈顯缺株，其產量乃受影響。

奇菌靈促進蔬菜成長之效能

諶 靜 吾　鄭 瑾 萍

一、前　　言

奇菌靈 (Gibberellin) 是一種以奇菌酸 (Gibberellic acid) 爲主要成分之植物生長素。近年來經美日各國學者之研究，證實其對多種植物有促進生長，增高產量，縮短休眠期，誘導單爲結果，提早種子發芽等功效。乃思試以奇菌靈施用於本省蔬菜，觀察其對蔬菜栽培上之功效。

二、試驗方法及結果

I. 第一次試驗　本試驗於民國46年下半年開始各項準備工作，47年春季作第一次試驗栽培，供試之蔬菜種類計有菠菜、芫荽、芹菜、胡瓜、白菜、蔓性菜豆等。Gibberellin 分別配成 1、10 及 100ppm 等三種濃度之水溶液，每處理以一畦爲單位，各重複 4～6 次。於發芽後，幼苗生長 3～4葉片時開始第一次處理，分別以不同濃度之 Gibberellin 液噴洒植株，以後每隔兩週重覆處理一次。至於栽培管理上如施肥，中耕除草等工作，均按普通菜園管理進行。

1. 菠菜供試品種爲 Minsterland，於47年 3 月13日播種，4 月13日開始第一次處理，前後處理共 3 次，於 5 月28日收穫。試驗結果如下表（表一及圖一）

表一　菠菜 (Minsterland)

Table 1. Spinach (Minsterland)

處理別 Treatments	每株重量 Wt. of plant	每株高度 Ht. of plant	葉片數 No. of leaves	葉柄長 Length of leaf-stalk	葉片長 Length of leaf	葉片寬 Width of leaf	抽苔率 % of bolting
	g	cm		cm	cm	cm	%
1 ppm	27.382	20.927	30.840	10.876	9.483	6.083	6.234
10 ppm	33.333	22.540	38.121	11.636	10.473	6.620	11.852
100 ppm	40.594	26.314	44.685	14.434	11.281	6.728	29.763
Check	29.923	20.378	41.520	10.340	10.255	6.336	1.388

附註：①葉片長、葉柄長、葉片寬三項數字係記載每株最大之葉片 3 枚，然後求其平均數。
②各處理記載20株，每處理各重複 4 次。

2. 芫荽　供試品種爲在來種，於47年 3 月13日播種，4 月14日開始第一次處理，前後處理共 3 次，於 5 月28日收穫。試驗結果如下表（表二及圖二）：

表二　芫荽（在來種）

Table 2. Coriander (Native variety)

處理別 Treatments	每株重量 Wt. of plant	每株高度 Ht. of plant	抽苔率 % of bolting
	g	cm	%
1 ppm	3.508	36.458	72.50
10 ppm	2.803	39.915	85.00
100 ppm	2.331	46.052	85.00
Check	3.129	31.525	51.25

3. 芹菜　供試品種爲黃心種，於47年２月15日播種，３月28日開始第一次處理，前後處理共４次，５月28日收穫。試驗結果如下表（表三）：

表三　芹菜（黃心種）

Table 3. Celery (Yellow Heart)

處理別 Treatments	每株重量 Wt. of plant	每株高度 Ht. of plant	根長 Length of root	抽苔率 % of bolting
	g	cm	cm	%
1 ppm	44.147	52.217	12.275	71.745
10 ppm	52.345	52.195	12.352	63.892
100 ppm	59.392	51.735	11.882	57.415
Check	37.550	46.042	12.287	69.267

4. 胡瓜　供試品種爲青胡瓜，於47年３月13日催芽，３月24日定植，４月12日開始第一次處理，前後處理共３次，於５月28日收穫，試驗結果如下表（表四）：

表四　胡瓜（青胡瓜）

Table 4. Cucumber (Green Skin)

處理別 Treatments	第一瓜着生節數 Segment of 1st fruit set	每瓜重量 Wt. of fruit	每瓜長度 Length of fruit	每瓜最寬橫徑 Maximum width of fruit	每瓜最狹橫徑 Mininum width of fruit
		g	cm	cm	cm
1 ppm	6～7	371.055	38.533	51.866	27.222
10 ppm	6～7	294.750	35.540	47.786	27.011
100 ppm	7～8	473.500	40.754	52.927	33.363
Check	5～6	295.454	36.281	46.963	26.354

5. 白菜　供試品種爲鳳山白菜，於47年６月３日播種，６月19日開始第一次處理，前後處理共２次，於７月20日收穫。試驗結果如下表（表五）：

表五　白菜（鳳山白菜）

Table 5. Pak-choi (Fengshan Pai Tsai)

處理別 Treatments	每株重量 Wt. of plant	每株高度 Ht. of plant	葉片數 No. of leaves	葉片長 Length of leaf	葉柄長 Length of leaf-stalk	葉片寬 Width of leaf
	g	cm		cm	cm	cm
1 ppm	40.53	23.82	8.64	17.72	3.21	10.97
10 ppm	32.69	22.42	8.28	17.65	2.41	10.61
100 ppm	30.93	23.98	8.11	18.58	1.59	9.93
Check	28.40	20.17	8.30	15.59	2.61	10.05

6. 蔓性菜豆　供試品種爲 Kentucky Wonder， 於47年３月13日播種 ，３月28日開始第一次處理，前後處理共２次。後因生長過高，未達開花結果時，支柱被風吹折，以至無豆莢重量，數目等之記載。僅將其植株攝影，以供參考（圖三）。

II. 第二次試驗　第二次試驗栽培，於47年秋季開始，供試種類計有蘿蔔、菠菜、甘藍、結球白菜、白菜、結球萵苣、花椰菜、芹菜及蔓性菜豆等，先後於９至10月間播種，12月底至翌年３月期間內收穫。因奇菌靈藥品之數量有限，除結球白菜用１、10及 100ppm 等三種濃度外，其他各種蔬菜僅用１及 10ppm 兩種濃度噴洒。第一次處理後每隔10日重覆一次至後穫止。玆將各項試驗分述於後：

1. 蘿蔔 供試品種爲美濃早生，於47年10月30日播種，11月26日開始第一次處理，以後每隔10日處理一次，前後共處理4次，於48年1月7日收穫。試驗結果列表如下（表六）：

表六 蘿蔔（美濃早生）
Table 6. Radish (Minon Early)

處理別 Treatments	每株葉長 Length of leaf	每株葉重 Wt. of leaves per plant	根重 Wt. of root	根長 Length of root	根徑 Width of root	分歧根百分比 % of branched root
	cm	g	g	cm	cm	%
1 ppm	34.76	477.1	917.45	40.72	6.335	15
10 ppm	36.11	476.1	929.05	42.71	6.229	5
Check	32.91	492.5	940.00	39.78	6.565	20

2. 菠菜 供試品種爲 Minsterland，於47年10月16日播種，11月26日開始第一次處理，前後共處理4次，於48月1月8日收穫，試驗結果如下（表七及圖四）：

表七 菠菜 (Minsterland)
Table 7. Spinach (Minsterland)

處理別 Treatments	每株重量 Wt. of plant	每株高度 Ht. of plant	葉片數 No. of leaves	葉長 Length of leaf	葉寬 Width of leaf
	g	cm		cm	cm
1 ppm	146.60	35.021	66.40	33.788	11.005
10 ppm	150.25	36.874	58.15	35.948	11.355
Check	87.75	27.183	58.00	26.290	8.916

3. 甘藍 供試品種爲長岡交配一號。於47年9月29日播種，10月14日移植，11月14日開始處理，前後共處理3次，於48年2月5日收穫。試驗結果如下表（表八）：

表八 甘藍（長岡交配一號）
Table 8. Cabbage (O-S Cross)

處理別 Treatments	每株株重 Wt. of plant	每株球重 Wt. of head	球徑 Width of head	球高 Ht. of head
	g	g	cm	cm
1 ppm	3,464.40	2,414.00	25.32	14.20
10 ppm	3,334.85	2,573.89	25.60	15.02
Check	3,518.25	2,526.70	25.02	15.05

4. 結球白菜 供試品種爲長岡交配二號，於47年9月29日播種，10月8日移植，11月3日開始處理，前後共處理4次，於12月26日收穫，試驗結果如下表（表九）：

表九 結球白菜（長岡交配二號）
Table 9. Pai-tsai (Nagaoka No.2)

處理別 Treatnlents	株重 Wt. of plant	球重 Wt. of head	球徑 Width of head	球高 Ht. of head
	g	g	cm	cm
1 ppm	2,619.33	1,652.00	14.69	28.872
10 ppm	2,369.33	1,487.50	14.02	26.666
100 ppm	2,699.66	1,749.66	14.87	28.228
Check	2,341.66	1,456.33	14.37	26.865

5. 白菜　供試品種爲青梗白菜，於47年10月15日播種，10月30日移植，11月26日開始處理，前後共處理4次，於48年1月5日收穫。試驗結果如下（表十）：

表十　白菜（青梗白菜）

Table 10. Pak-choi (Ching-keng Pe-tsai)

處理別 Treatments	每株高度 Ht. of plant	每株重量 Wt. of plant
	cm	g
1 ppm	35.675	1,122.50
10 ppm	36.780	1,245.00
Check	34.887	1,150.30

6. 結球萵苣　供試品種爲 Great Lake，於47年9月27日播種，10月14日移植，11月14日開始處理，前後共處理5次，於48年1月9日收穫。試驗結果如下表(表十一，圖五、六、七、八)：

表十一　結球萵苣 (Great Lake)

Table 11. Lettuce (Great Lake)

處理別 Treatments	株重 Wt. of plant	球重 Wt. of head	球徑 Width of head	球高 Ht. of head	結球率 % of heading
	g	g	cm	cm	%
1 ppm	1,238.19	762.27	16.72	14.15	34.37
10 ppm	1,255.71	759.29	15.04	13.84	21.21
Check	1,294.25	878.75	14.21	13.54	100.00

附註：上表數字因處理者結球率極低，記載數字係取結球植株平均而得，其他不結球，或形狀不整畸形之植株，攝影以供參考。

7. 花椰菜　供試品種爲中生種，於47年10月15日播種，10月30日移植，11月26日開始處理，前後共處理4次，於48年2月6日收穫。試驗結果如下（表十二）：

表十二　花椰菜（中生種）

Table 12. Cauliflower (Medium Maturing)

處理別 Treatments	全株重 Wt. of plant	花球重 Wt. of head
	g	g
1 ppm	1,023.11	549.11
10 ppm	1,021.00	535.00
Check	1,001.55	566.55

8. 芹菜　供試品種爲黃心種：於47年10月16日播種，12月9日開始處理，前後共處理5次，於48年3月2日收穫。試驗結果如下（表十三，圖九）：

表十三　芹菜（黃心種）

Table 13. Celery (Yellow Heart)

處理別 Treatments	株重 Wt. of plant	株高 Ht. of plant	葉片數 No. of leaves	抽苔率 % of bolting
	g	cm		%
1 ppm	41.15	48.98	9.20	27.50
10 ppm	31.81	47.35	8.45	30.00
Check	39.83	47.94	10.00	15.00

9. 蔓性菜豆　供試品種爲 Kentucky Wonder，於47年10月16日播種，11月8日開始處理，前後共處理6次。於48年1月14日收穫。試驗結果如下（表十四，圖十、十一）：

表十四　蔓性菜豆 (Kentucky Wonder)

Table 14. Pole Bean (Kentucky Wonder)

處理別 Treatments	每株豆莢數 No. of pods per plant	豆莢重 Wt. of pod	豆莢長 Length of pod	結實率 % of pod setting
		g	cm	%
1 ppm	17.6	11.885	16.724	100
10 ppm	3.5	5.830	10.240	40
Check	23.7	10.770	16.471	100

Ⅲ. 第三次試驗　第三次栽培試驗於48年7月開始，8月收穫。供試種類爲青梗白菜及鳳山白菜兩種白菜。此次供試之藥劑有兩個來源，一爲美國 Pfizer 藥廠出品之純粹 Gibberellic acid。一爲臺糖公司臺南糖業試驗所提煉之粗結晶，含 Gibberellic acid 38%。兩種均各配成1、10、50及 100 ppm 四種不同濃度之水溶液。

1. 青梗白菜　於48年7月11日播種，13日發芽，23日移植，8月1日開始第一次噴射，以後每隔10日噴射一次，前後共處理3次，於8月26日收穫。試驗結果如下（表十五）：

表十五　青梗白菜

Table 15. Pak-choi (Ching-keng Pe-tsai)

處理別 Treatments		株高 Ht. of plant	株重 Wt. of plant	葉數 No. of leaves	葉長 Length of leaf	葉寬 Width of leaf
		cm	g		cm	cm
A	1 ppm	26.730	169.9	18.25	24.09	13.06
	10 ppm	29.568	176.6	15.72	24.76	13.07
	50 ppm	24.886	105.6	17.20	21.79	10.65
	100 ppm	30.354	181.6	19.02	25.02	12.95
B	1 ppm	25.539	170.0	18.24	22.91	11.55
	10 ppm	28.330	190.0	19.81	24.18	12.61
	50 ppm	30.570	162.1	16.09	25.10	12.82
	100 ppm	32.579	171.3	16.86	24.41	12.40
Check		26.705	176.0	17.94	23.70	11.86

附註：處理別 A，爲美國 Pfizer 藥廠出品之 Gibberellin。
　　處理別 B，爲臺南糖業試驗所提煉之 Gibberellic acid 粗結晶。

2. 鳳山白菜　於48年7月11日播種，7月23日移植，8月1日開始第一次處理，前後共處理3次，於8月26日收穫。試驗結果如下（表十六）：

表十六 鳳山白菜

Table 16. Pak-choi (Fengshan Pe-tsai)

處理別 Treatments		株高 Ht. of plant cm	株重 Wt. of plant g	葉數 No. of leaves	葉長 Length of leaf cm	葉寬 Width of leaf cm
A	1 ppm	29.576	196.0	12.30	28.13	17.18
	10 ppm	29.720	153.0	12.20	27.59	16.54
	50 ppm	30.590	135.0	11.73	26.29	15.90
	100 ppm	35.893	348.0	13.00	29.06	16.84
B	1 ppm	30.576	235.0	13.86	27.75	16.98
	10 ppm	32.386	207.0	12.41	29.75	17.62
	50 ppm	35.480	190.0	13.43	29.93	19.04
	100 ppm	36.286	165.0	13.52	28.91	14.44
Check		31.470	225.0	13.21	27.88	17.66

附註：處理別A及B，與表十五同。

三、結　　論

玆就上列各表結果數字分析之，得初步結論如下：

一、蘿蔔　各處理之蘿蔔不論地上部或地下部之長度，均較對照區大。而重量反較對照區小。就形狀言之，處理者根部之分歧所佔之百分率較對照區低。

二、菠菜　兩次試驗結果，處理區不論濃度高低，對平均每株高度及產量與對照區比較，均有增加。春播者各處理區均有提早抽苔現象，抽苔率亦較對照區高。秋播者收穫時尙未開始抽苔。

三、芫荽　處理區植株高度及抽苔率較對照區增高，其增高程度與奇菌靈之濃度成正比。而植株重量則較對照區低，且與奇菌靈之濃度成反比。

四、胡瓜　處理區第一瓜着生節數較對照區延後1～2節，每瓜重量，長度，橫徑大小等較對照區有增加，惟 10 ppm 者每瓜重量及長度較對照略有減少。

五、結球白菜　三種處理在株重與球重方面均較對照稍有增加，球徑與球高兩項除 10 ppm 處理較對照略低外，均略超過對照區，惟相差數不太顯著。

六、甘藍　甘藍因葉片上有臘質，奇菌靈液中雖加用展着劑，亦不易附着，且第三次處理後，開始結球而停止處理，結果數字無明顯差異。

七、花椰菜　處理區植株重量雖較對照略有增加，但食用部份花球之重量反較對照減少。

八、結球萵苣　處理區濃度愈高，結球率愈低，對照區則百分之百結球。不結球者植株形狀亦極不規則。結球者處理區之株重及球重均較對照低，而球之大小（球徑與球高）反較對照區大，故知處理者雖能結球，球之緊密度亦不及對照區。

九、蔓性菜豆　兩次試驗結果，知不同濃度之奇菌靈液對蔓性菜豆之植株有顯著增長，其增長率與濃度高低成正比。植株之分枝數亦隨濃度之昇高而加多。開花早晚，結實率，豆莢大小，重量等反因濃度增大而不及對照區。

十、芹菜　第一次試驗結果，對於株高、株重，各處理均較對照爲佳，而以濃度愈高反應愈優，對抽苔之影響並不明顯。

第二次秋播結果，各處理區之株高、株重與對照無明顯差別，而抽苔率則因濃度不同較對照區比例增加。

十一、青梗白菜　經處理者在株高與株重方面，均以濃度愈高者效果愈佳，僅美製奇菌靈 50 ppm 者較差，他種濃度，包括臺南糖試所及美國 Pfizer 廠之奇菌靈的結果相若。

十二、鳳山白菜　第一次試驗結果，以 1 ppm 處理者較高濃度爲佳，惟各處理均較對照區爲優。

第二次試驗結果，株高均按濃度高低比例增加，重量反而相對減少。不及對照區，惟美製奇菌靈 100 ppm 者例外。此外兩種奇菌靈之差異甚微。

THE EFFECT OF GIBBERELLIN ON PROMOTION OF VEGETABLES GROWTH

by

C. W. Shen, C. P. Cheng

SUMMARY

1. Radish (Minon Early): The length of either the leaves or the roots of treated radishes is longer than that of the check ones, while the weight is lighter, and the percentage of branches of the treated radish root is smaller.

2. Spinach (Minsterland): According to the results of two tests, no matter the concentration is low or high, the average length per plant and the production of the treated ones are increased. The treated spring seeding ones bolted early, the percentage of bolting is higher than that to the check ones. Fall seeding ones had not begun to bolt till harvest.

3. Coriander (Native variety): The length of stem and the bolting ratio of the treated corianders are higher than those of the check ones. The weight of plants is quite the opposite.

4. Cucumber (Green Skin): The setting location of the first fruit of the treated ones is one or two nodes latter than the check ones. The weight, length and diameter of each cucumber are increased except the 10 ppm ones.

5. Pai-tsai (Nagaoka No. 2): The plant weight and the head weight of the three treatments are increased. The head diameter and the head length are increased except 10 ppm ones, but the difference is not so large.

6. Cabbage (O-S Cross): The wax of cabbage prevents the gibberellin from adhering to the leaf, in spite of the stick used. After the third treatment the cabbages begin to set heads. And the treatment is stopped. The result shows little difference.

7. Cauliflower (Medium maturing): The plant weight of the treated ones is increased but the weight of the flower is lighter than the check ones.

8. Lettuce (Great Lake): The heading ratio is opposite proportional to the concentration while the check ones are all headed· The plant shapes of unheaded

ones are quite irregular. The plant weight and head weight of the headed lettuce of the treated ones are lighter than those of the check ones, but the head size (head diameter and head length) is larger, so that we know though the treated ones can head, the density of the head is looser.

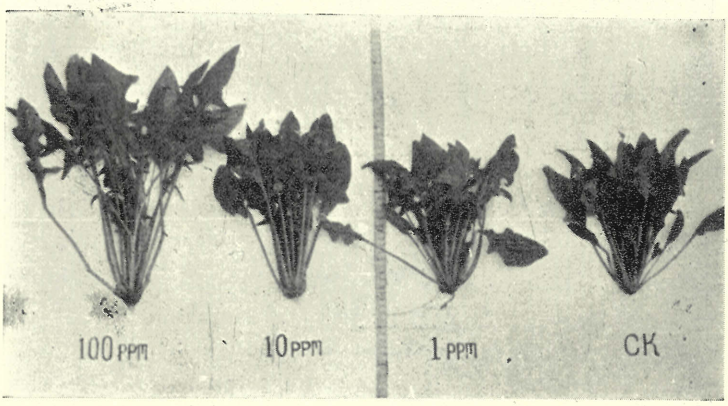
9. Pole Bean (Kentucky Wonder): According to the results of two tests, we know that gibberellin solution of different concentration increases the plant length of pole bean, and the increase ratio is proportional to the concentration. The number of the plant branching increases in the same way. Leaf size, bloom time, fruit setting ratio, pod size and weight are in a worse condition than those of the check ones because of the increase of concentation.

10. Celery (Yellow Heart): From the first test we know that all the plant height and weight of the treated ones are better than those of the check ones, and denser concentration causes better reaction, but it does not affect bolting much.

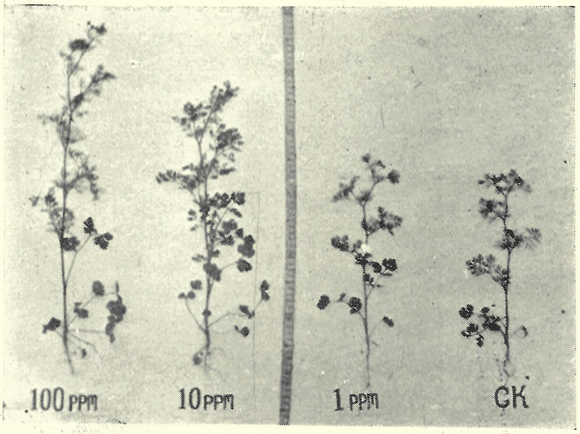
After the second fall seeding, it shows great difference, and the bolting ratio increases because of different concentration, while compared with that of the check ones.

11. Pak-choi (Ching-keng pai-tsai): The plant height and weight of the treated ones are proportional to the coecentration. Only those treated with 50 ppm of U. S. made gibberellin are worse. Those treated with the other two kinds of gibberellin (one is Taiwan Sugar Research Institute made, the other is American Pfizer made) show same results.

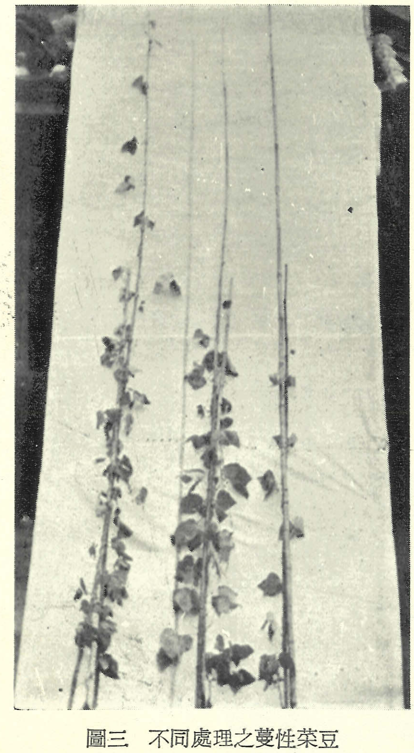
12. Pak-choi (Fengshan pai-tsai): The first test shows the treatments are all better than those of the check ones but the one treated with 1 ppm gibberellin is the best. The second test shows plant height increases as the concentration increases and the weight is on the contraty. All the treated ones are worse than those of the check ones except those treated with 100 ppm of American made gibberellin. Those treated with the other two kinds of gibberellin show little difference.



圖一 不同處理之菠菜
Fig. 1 Spinach with different treatments

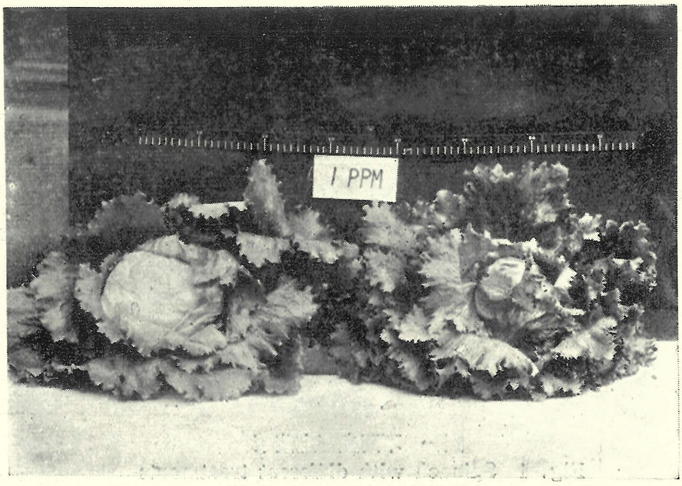


圖二 不同處理之芫荽
Fig. 2 Coriander with different treatments

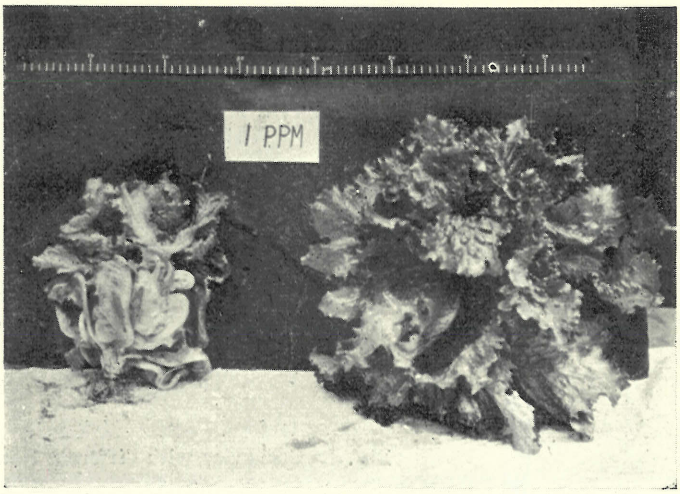


圖三 不同處理之蔓性菜豆
Fig. 3 Pole Bean with different treatments

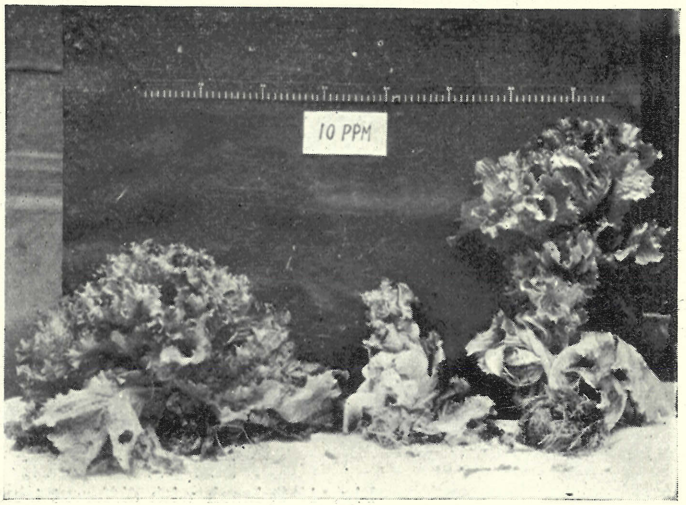
圖四 不同處理之菠菜
Fig. 4 Spinach with different treatments



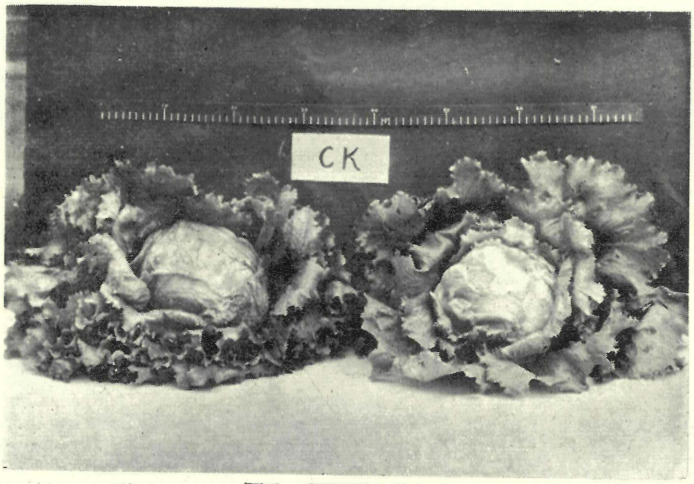
圖五 1 ppm 處理之萵苣
Fig. 5 Lettuce treated with 1 ppm gibberellin



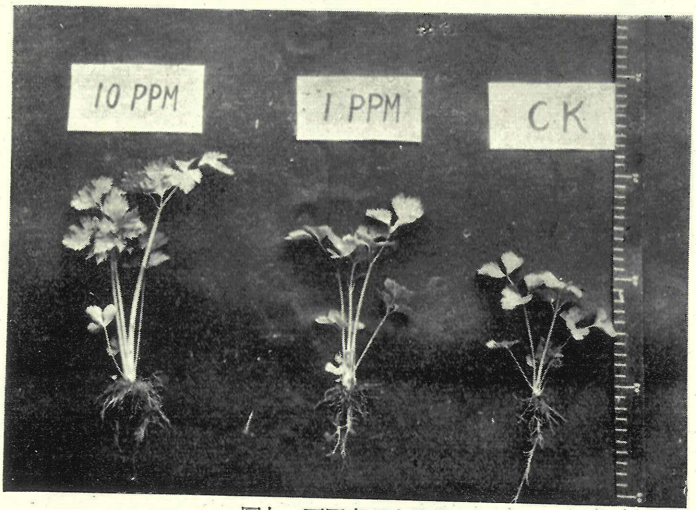
圖六 1pqm 處理之萵苣畸形株
Fig. 6 Abnormal plant of lettuce because of treatment with 1 ppm gibberellin



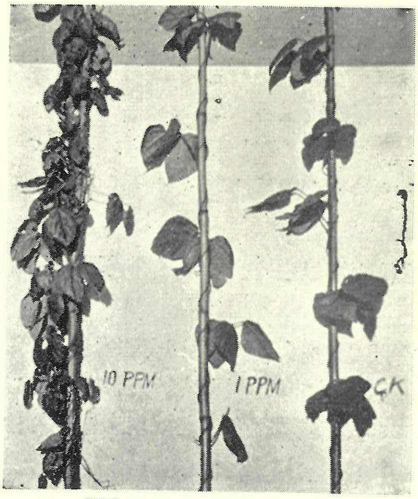
圖七 10ppm 處理之萵苣
Fig. 7 Lettuce treated with 10 ppm gibberellin



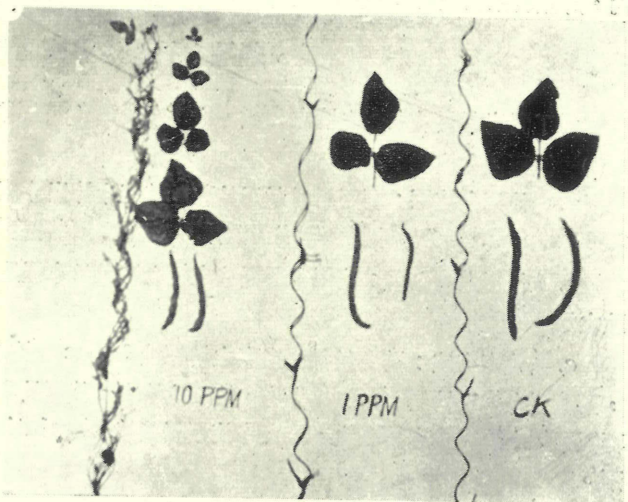
圖八　對照區之萵苣
Fig. 8　Lettuce of check control



圖九　不同處理之芹菜
Fig. 9　Celery with different treatments



圖十　不同處理之菜豆植株
Fig. 10　Plants of pole bean with different treatments



圖十一　不同處理之菜豆豆莢
Fig. 11　Pods of pole bean with different treatments

馬鈴薯種薯供應試驗

(第二報)馬鈴薯X毒素病抗血淸之製造及力價之檢定

郭　國　柱

一、前　　言

馬鈴薯種薯之生產最重要的問題是如何來控制毒素病的發生，如能避免毒素病之傳染，所產之種薯就可以說是優良種薯了。在多種馬鈴薯毒素病中以X毒素病最爲普遍，也最麻煩，因爲植株感染該種病毒後，常不易顯出病徵，因此人工淘汰困難，而引起該病之蔓延，以接種方法雖然可檢出染病植株，但手續較煩雜，所需時間較長，所以不甚理想；因此目前多用抗血淸來檢定，這種方法比較簡單，馬上可以檢別，並且相當正確。

二、抗血淸之製造

(1) X Virus 汁液（抗原）：將男爵種馬鈴薯縮葉毒素病 (Rugose mosaic) 罹病病株葉片摘下搾液後用紗布過濾，裝入薄壁之玻璃試管，置於 60°C 溫水內10分鐘，使汁液中 YVirus 不活性化，將此液以摩擦法接種於蕃茄，感染之蕃茄作爲 X Virus 之給源。

(2) 注射材料：將上述之感染蕃茄嫩葉搾液後，以 Bowden and Pirie 法，精製後供爲應用。

(3) 家兎之注射：於民國49年12月22日將購買之家兎 4 隻（每隻2～3公斤左右）開始第一次注射，即每隻使用精製液 2cc 由耳靜脈注射後，每隔 7 天使用精製液 3cc 注射到第四次，第四次注射後 5 天即於 1 月17日，採一份血液（由心臟抽出）檢定其免疫力價，於 1 月19日第五次之注射。（家兎 4 隻中 1 隻於 1 月16日死去剩 3 隻）

(4) 血淸之製造：第五次注射後 6 天，即於 1 月25日以頸動脈抽血法抽出全血，3 隻總採血量 250cc，經精製後得血淸 120cc，以防腐爲目的加二萬分之一之 Merzonin 後，裝入 2cc Ample 內，貯藏於冰箱（約 1°C）以供應用。

三、製造之抗血淸免疫力價之檢定

爲了明瞭所製造之抗血淸之力價，用日本製造之抗血淸爲對照作檢定。

(1) 抗原價之檢定：

a. 使用之抗原：利用男爵種馬鈴薯將其葉片搾出汁液，凍結16小時後溶解，再以離心機經過 3,000 r.p.m. 30分鐘分離後倒出淸澄汁液，以下列稀釋倍數用生理食鹽水稀釋，供爲檢定之用。

b. 使用之抗血淸：使用本所製造之抗血淸及日本製造之抗血淸以生理食鹽水稀釋爲16倍供試驗之用。

c. 檢定方法：將各種稀釋濃度之抗原液 0.25cc 加抗血淸 0.25cc（另使用生理食鹽水爲對照），兩液混合後置於 37°C溫水2小時，第一次檢查，後置於 3～5°C之冷室經過4小時，第二次檢查；再經過16小時後檢查第三次，檢查時使用凝集鏡 (Agglutinoscope) 檢視混合液之絮狀沈降物之情形。

d. 檢查結果：

檢定次別	抗原稀釋倍數 / 抗血清來源	2	4	8	16	32	64	128	256	512	CK
第一次	日本(16倍稀釋數)	+	?	—	—	—	—	—	—	—	—
	本所(16倍稀釋數)	+	?	—	—	—	—	—	—	—	—
第二次	日本(16倍稀釋數)	++	+	+	?	—	—	—	—	—	—
	本所(16倍稀釋數)	++	+	+	?	—	—	—	—	—	—
第三次	日本(16倍稀釋數)	+++	+++	++	++	+	+	?	—	—	—
	本所(16倍稀釋數)	+++	+++	++	++	+	+	?	—	—	—

按上表在第一次即兩液混合後置於 37°C 溫水 2 小時檢查，其抗原稀釋到 2 倍時亦可看到稍有沈澱，稀釋到 4 倍時似有一點沈澱，但似有可疑，在第二次即第一次檢查後置於 3～5°C 之冷室，經過 4 小時檢查，結果稀釋 2 倍其沈澱較多，稀釋 4 倍及 8 倍者稍有沈澱，稀釋16倍者似有一點沈澱，仍似有疑問，在第三次即第二次檢查後，繼續置於 3～5°C 經過16小時檢查，結果稀釋 2 倍及 4 倍者沈澱甚多，稀釋 8 倍及16倍，澱較多，32倍及64倍者稍有沈澱，稀釋 128 倍者似有一點沈澱，仍似有疑問。

(2) 抗血清免疫力價之檢定：

a. 使用之抗原：使用在上項所用之男爵種葉片精製搾取，使用時不稀釋。

b. 使用之抗血清：使用本所製造之血清及以日本製造之血清爲對照，使用時以生理食鹽水稀釋。

c. 檢定方法：將各種稀釋濃度之抗血清 0.25cc，加抗原 0.25cc（另用食鹽水爲對照），兩液混合後置於 37°C 溫湯 2 小時後檢查第一次，後置於3～5°C之冷室經過 4 小時檢查第二次，再經過16小時後檢查第三次，檢查時使用凝集鏡 (Agglutinoscope) 檢視混合液之絮狀沈降物之情形。

d. 檢定結果：

檢定次別	抗血清稀釋倍數 / 抗血清之來源	4	8	16	32	64	128	256	512	1024	CK
第一次	日本	++	++	++	+	+	+	?	—	—	—
	本所	++	++	++	+	+	+	?	—	—	—
第二次	日本	+++	++	++	++	+	+	+	?	—	—
	本所	+++	++	++	++	+	+	+	?	—	—
第三次	日本	+++	+++	++	++	++	+	+	+	?	—
	本所	+++	+++	++	++	++	+	+	+	?	—

按上表在各種稀釋倍數本所製造的和日本製造的反應均相等。

即在第一次檢查時，兩種抗血清稀釋 4 倍、8 倍及16倍者沈澱較多，32倍、64倍及 128 倍者稍有沈澱，256倍者似有一點沈澱，512倍及 1,024 倍者和對照者卽無沈澱，於第二次檢查時兩種抗血清稀釋 4 倍者沈澱甚多，8 倍、16倍及32倍者次之，64倍、128 倍及 256倍者均稍有沈澱，512倍者似有一點沈澱，1,024 倍者和對照者卽無沈澱，第三次檢查時亦以兩種抗血清稀釋 4 倍及 8 倍者沈澱甚多，16倍、32倍及64倍者次之，128倍、256倍及 512倍者稍有沈澱，1,024倍者似有一點沈澱，對照者卽無沈澱。

(3) 討　　論

在本所製造之X毒素病抗血清，以男爵種葉汁檢定其力價結果，於每次檢定均與日本製造之抗血清反應相同，並在第三次檢定時，稀釋 512 倍尚可檢出有沈澱，可謂本所製造之X毒素病抗血清不遜於日本製造者，並可實際應用。

四、摘　　要

爲利用抗血清檢定馬鈴薯X毒素病，而利生產優良馬鈴薯種薯起見，於1961年（民國50年）1月在本所製造馬鈴薯X毒素病抗血清，結果得精製血清 120cc，並爲了明瞭該抗血清之免疫力價，使用男爵種馬鈴薯葉汁，並以日本製造之同樣之抗血清以沈澱反應作比較結果，兩種抗血清反應均相同，即可證明本所製造之抗血清甚有應用價值。

EXPERIMENT ON SEED POTATO PRODUCTION (2) THE PREPARATION AND TEST OF ANTISERUM TO POTATO VIRUS X

by

K. C. Kuo

SUMMARY

The utilization of antiserum has been recognized as an easy and effective method to find latency potate virus X.

The author prepared 120 c. c. of antiserum by Bowder and Pirie method, furthermore compared its efficiency with products of Japan, and the result may be satisfied.

柑桔嫁接應用植物荷爾蒙試驗

（第二報）植物荷爾蒙對於柑桔接枝切面癒合能力之研究

翁　仁　祿

一、前　　言

爲解決柑桔毒素病之墨西哥雷姆週年檢定的可能性，以及在不適時期從國外引進優良系統之柑桔接穗能即時嫁接繁殖計，研究柑桔週年嫁接成活之問題實屬急需，筆者有鑒於此，擬利用植物荷爾蒙之刺戟細胞促進分裂之作用，以增加其癒合能力而提高嫁接之成話率，曾自 1962 年 7 月起至 1963年 6 月止，於臺灣省農業試驗所園藝系採用 IA、IB，兩種藥劑作初步觀察試驗，將試驗結果整理作爲第一報。惟上試驗供試株數尚嫌甚少，恐有影響準確度，故以增加荷爾蒙種類及供試株數，研究各種植物荷爾蒙對柑桔接枝切面之癒合能力問題。

本試驗承國家長期科學發展委員會之經費補助得以進行，又文成後承嚴夢如、諶靜吾兩先生之校閱，特誌謝忱。

二、材 料 及 方 法

(一)　材料

1. 接穗：高墭桶柑　　2. 砧木：二年生酸桔苗
3. 包紮物：白色塑膠帶（厚0.05mm）　　4. 覆蓋物：白色塑膠袋（厚0.03mm）及竹葉
5. 植物荷爾蒙 α-Naphthaleneactic acid, β-Indoleacetic acid. β-Indolebutyic acid.

(二)　方法

本試驗係採用本省普遍採用之有切接法，自民國52年 8 月起，每隔 2 個月採用新鮮技條爲接穗（6—8 月份採用春芽，10—12月採用第一期夏芽，2 月採用第二期夏芽，4 月份採用秋冬芽）嫁接一次。將接穗調整後浸於濃度不同之各溶液內一分鐘後供接木，每處理重複二次每區五十株，嫁接四週後打開覆蓋物檢查成活率觀察初期生長高度及切面癒合組織（Callus）等情形。

各處理使用之植物荷爾蒙種類及濃度如表一：

表一　各處理區之植物荷爾蒙種類及濃度

處理代號		
1.	β-Indoleacetic acid 50ppm	IA 50ppm
2.	β-Indoleacetic acid 100ppm	IA 100ppm
3.	β-Indoleacetic acid 200ppm	IA 200ppm
4.	β-Indolebutyric acid 50ppm	IB 50ppm
5.	β-Indolebutyric acid 100ppm	IB 100ppm
6.	β-Indolebutyric acid 200ppm	IB 200ppm
7.	α-Naphthaleneacetic acid 50ppm	NA 50ppm
8.	α-Naphthaleneacetic acid 100ppm	NA 100ppm
9.	α-Naphthaleneacetic acid 200ppm	NA 200ppm
10.	Check	ck

三、試 驗 結 果 四

8 月份處理於民國52年 8 月 5 日施行，9 月 4 日打開覆蓋物檢查成活率等，10月份於10月 5 日處理11月 5 日檢查，12月份於12月 4 日處理於民國53年 1 月 3 日檢查，2 月份於同年 2 月 6 日處理於 3 月 8 日檢查，4 月份於 4 月 4 日處理於 5 月 4 日檢查，6 月份由於須結束本試驗之需要提早於 5 月22日處理於 6 月12日檢查，同年試驗成績如下：

1.　成活率：嫁接處理約一個月後打開覆蓋物檢查成活率結果如表二：

表二 柑桔嫁接周年成活率比較表

代號	八月份 成活株 I	II	計	成活率	指數	十月份 成活株 I	II	計	成活率	指數	十二月份 成活株 I	II	計	成活率	指數	二月份 成活株 I	II	計	成活率	指數	四月份 成活株 I	II	計	成活率	指數	六月份 成活株 I	II	計	成活率	指數
1	31	21	52	52	102	23	26	49	49	143	24	22	46	46	75	44	40	84	84	90	3	2	5	5	56	23	20	43	43	179
2	25	26	51	51	100	15	13	28	28	88	21	34	55	55	93	44	48	92	92	99		3	3	3	33	15	9	24	24	100
3	37	41	78	78	153	33	25	58	58	181	16	25	41	41	69	44	48	92	92	99	3	4	7	7	78	15	18	33	33	138
4	38	41	79	79	155	29	31	60	60	188	24	27	51	51	86	35	39	74	74	80	2	6	8	8	89	20	18	38	38	158
5	37	20	57	57	112	31	17	48	48	150	37	47	84	84	142	47	46	93	93	100	5	6	11	11	122	36	39	75	75	313
6	25	12	37	37	72	32	27	59	59	184	36	42	78	78	132	45	44	89	89	96	2	6	8	8	89	32	39	71	71	296
7	31	25	56	56	110	31	33	64	64	200	23	32	55	55	93	45	45	90	90	97	2	13	15	15	167	11	14	25	25	104
8	36	36	72	72	141	31	32	63	63	197	32	36	68	68	115	45	43	88	88	95	3	3	6	6	67	25	34	59	59	246
9	18	27	45	45	88	19	19	38	38	118	36	38	74	74	125	47	49	96	96	103	1	1	2	2	22	8	6	14	14	58
10	26	25	51	51	100	18	14	32	32	100	33	26	59	59	100	48	45	93	93	100	1	8	9	9	100	9	15	24	24	100

(1) 8月份嫁接成活率分析結果如表三：

表三 8月份嫁接成活率分析表

變　　因	自由度	平方和	均方和	實際F值	理論F值 5 %	理論F值 1 %
重　　複	1	45.00	45.00	1.32	5.12	10.56
處　　理	(9)	892.80	99.20	2.92	3.17	5.35
荷爾蒙處理與否	1	25.70	25.70	0.76	5.12	10.56
荷爾蒙間	8	867.10	108.38	3.19	3.23	5.46
機　　差	9	306.00	34.0			
總　　數	19	1243.80				

(2) 10月份嫁接成活率分析及差異比較結果如表四、五：

表四 10月份嫁接成活率分析表

變　　因	自由度	平方和	均方和	實際F值	理論F值 5 %	理論F值 1 %
重　　複	1	31.25	31.25	2.16	5.12	10.56
處　　理	(9)	783.45	87.05	6.02※※	3.17	5.35
荷爾蒙處理與否	1	178.00	178.00	12.30※※	5.12	10.56
荷爾蒙間	8	605.45	75.68	5.23※	3.23	5.46
機　　差	9	130.25	14.47			
總　　數	19	944.95				

※＝差異顯著標誌　　※※＝差異極顯著標誌

表五 10月份各處理間嫁接成活率比較長

處理代號	成活率									
7	64									
8	63	1								
4	60	4	3							
6	59	5	4	1						
3	58	6	5	2	1					
1	49	15	14	11	10	9				
5	48	16	15	12	11	10	1			
9	38	26	25	22	21	20	11	10		
10	32	32	31	28	27	26	17	16	6	
2	28	36	35	32	31	30	21	20	10	4

〰〰差異顯著所需差數＝8.5956—差異極顯著所需差數＝12.3500

(3) 12月份嫁接成活率分析結果如表六：

表六　12月份嫁接成活率分析表

變因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重複	1	110.45	110.45	6.14※	5.12	10.56
處理	(9)	918.45	102.05	5.60※※	3.17	5.35
荷爾蒙處理與否	1	2.45	2.45	0.13	5.12	10.56
荷爾蒙間	8	916.00	114.50	6.28※※	3.23	5.46
機差	9	164.05	18.23			
總數	19					

※＝差異顯著標誌　※※差異極顯著標誌

註：重複間有顯著標誌，處理及荷爾蒙間有極顯著之標誌，表示重複間及各荷爾蒙間之顯著之藥效，但各荷爾蒙處理與對照者間並無顯著差異，不符合本試驗目的之故，不再作各處理間之差異分析。

(4) 2月份嫁接成活率分析結果如表七：

表七　2月份嫁接成活率分析表

變因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重複	1	0.45	0.45	0.098	5.12	10.56
處理	(9)	175.45	19.49	4.274※	3.17	5.35
荷爾蒙處理與否	1	8.45	8.45	1.853	5.12	10.56
荷爾蒙間	8	167.00	20.88	4.579※	3.23	5.46
機差	9	41.05	4.56			
總數	19					

※＝差異顯著標誌

註：處理及荷爾蒙間有顯著標誌，表示各荷爾蒙間有顯著之藥效，但各荷爾蒙處理與對照者間並無顯着差異，不符合本試驗目的之故，不另作各處理間之差異分析。

(5) 四月份嫁接成活率分析結果如表八：

表八　四月份嫁接成活率分析表

變因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重複	1	45.00	45.00	6.53※	5.12	10.56
處理	(9)	65.20	7.24	1.05	3.17	5.35
荷爾蒙處理與否	1	1.42	1.42	0.21	5.12	10.56
荷爾蒙間	8	63.78	7.97	1.16	3.23	5.46
機差	9	62.00	6.89			
總數	19	172.00				

(6) 6月份嫁接成活率分析及差異比較結果如表九、十：

表九 6月份嫁接成活率分析表

變因	自由度	平方和	均方和	實際F值	理論F值	
					5%	1%
重複	1	16.20	16.20	1.37	5.12	10.56
處理	(9)	2009.20	223.24	18.89※※	3.17	5.35
荷爾蒙處理與否	1	153.09	153.09	12.90※※	5.12	10.56
荷爾蒙間	8	1856.11	232.01	19.54※※	3.23	5.46
機差	9	106.80	11.87			
總數	19					

※＝差異顯著標誌

表十 6月份各處理間嫁接成活率比較表

處理代號	成活率									
5	75									
6	71	4								
8	59	16	12							
1	43	32	28	16						
4	38	37	33	21	5					
3	33	42	38	26	10	5				
7	25	50	46	34	18	13	8			
2	24	51	47	35	19	14	9	1		
10	24	51	47	35	19	14	9	1	0	
9	14	61	57	45	29	24	19	11	10	10

〰〰差異顯著所需差數＝7.797，差異極顯著所需差數＝11.213

2. 幼芽生長高度：嫁接處理約一個月後打開覆蓋物調查幼芽高度結果如表十一：

表十一 柑桔嫁接後幼芽生長高度比較表

代號	八月份				十月份				十二月份				二月份				四月份				六月份			
	幼芽高度			指數	幼芽高度			指數	幼芽高度			指數	幼芽高度			指數	幼芽高度			指數	幼芽高度			指數
	I	II	平均		I	II	平均		I	II	平均		I	II	平均		I	II	平均		I	II	平均	
1	8.0	5.6	6.8	57	0.9	0.7	0.8	800	1.3	0.7	1.0	100	3.0	5.9	4.5	75	5.4	1.7	3.6	1,800	0.2	0.6	0.4	133
2	8.6	13.6	11.1	93	1.3	2.7	2.0	2,000	0.2	0.4	0.3	30	6.5	6.4	6.5	108	—	2.2	1.1	550	—	—	—	—
3	17.0	17.8	17.4	145	0.9	3.1	4.0	2,000	1.1	4.7	2.9	290	7.3	7.6	7.5	125	3.3	—	1.7	850	0.1	0.3	0.2	67
4	7.9	13.3	10.6	88	0.1	0.7	0.4	400	2.1	1.9	2.0	200	3.9	6.6	5.3	88	5.0	—	2.5	1,250	—	—	—	—
5	6.3	13.5	9.9	83	—	—	—	—	0.5	1.3	0.9	90	6.1	6.1	6.1	103	1.3	0.2	0.8	400	0.4	0.2	0.3	100
6	6.0	2.8	4.4	37	0.9	0.3	0.6	600	1.9	2.7	2.3	230	4.8	4.9	5.9	98	3.3	3.4	3.4	1,700	—	0.2	0.1	33
7	19.3	7.9	13.6	113	0.8	0.4	0.6	600	2.0	2.2	2.1	210	1.5	2.2	1.9	32	1.2	1.0	1.1	550	0.4	—	0.2	67
8	9.6	6.6	8.1	68	1.3	0.3	0.8	800	1.5	2.5	2.0	200	4.7	6.2	5.5	92	0.4	0.7	0.6	300	—	—	—	—
9	0.7	2.3	1.5	13	0.1	0.1	0.1	100	0.5	0.9	0.7	70	5.4	3.1	4.3	71	—	—	—	—	—	—	—	—
10	8.4	15.6	12.0	100	0.1	0.1	0.1	100	0.7	1.3	1.0	100	6.9	5.0	6.0	100	—	0.4	0.2	100	—	0.6	0.3	100

(1) 8月份嫁接後幼芽生長高度分析結果如表十二：

表十二　8月份嫁接後幼芽生長高度分析表

變　因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重　複	1	2.59	2.59	0.15	5.12	10.56
處　理	(9)	377.29	41.92	2.43	3.17	5.35
荷爾蒙處理與否	1	13.45	13.45	0.78	5.12	10.56
荷爾蒙間	8	363.84	45.48	2.63	3.23	5.46
機　差	9	155.41	17.27			
總　數	19	535.29				

(2) 10月份嫁接後幼芽生長高度分析結果如表十三：

表十三　10月份嫁接後幼芽生長高度分析表

變　因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重　複	1	0.20	0.20	0.43	5.12	10.56
處　理	(9)	9.41	1.05	2.27	3.17	5.35
荷爾蒙處理與否	1	0.91	0.91	1.98	5.12	10.56
荷爾蒙間	8	8.50	1.06	2.31	3.23	5.46
機　差	9	4.16	0.46			
總　數	19	13.77				

(3) 12月份嫁接後幼芽生長高度分析結果如表十四：

表十四　12月份嫁接後幼芽生長高度分析表

變　因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重　複	1	2.31	2.31	2.66	5.12	10.56
處　理	(9)	10.79	1.20	1.38	3.17	5.35
荷爾蒙處理與否	1	0.60	0.60	0.69	5.12	10.56
荷爾蒙間	8	10.19	1.27	1.47	3.23	5.46
機　差	9	7.81	0.87			
總　數	19	20.91				

(4) 2月份嫁接後幼芽生長高度分析結果如表十五：

表十五　2月份嫁接後幼芽生長高度分析表

變　因	自由度	平方和	均方和	實際F值	理論F值	
					5 %	1 %
重　複	1	1.74	1.74	0.82	5.12	10.56
處　理	(9)	37.12	4.13	1.94	3.17	5.35
荷爾蒙處理與否	1	0.93	0.93	0.43	5.12	10.56
荷爾蒙間	8	36.20	4.53	2.12	3.23	5.46
機　差	9	19.19	2.13			
總　數	19	58.06				

(5) 4 月份嫁接後幼芽生長高度分析結果如表十六：

表十六 4 月份嫁接後幼芽生長高度分析表

變因	自由度	平方和	均方和	實際 F 值	理論 F 值	
					5 %	1 %
重複	1	5.30	5.30	2.83	5.12	10.56
處理	(9)	28.48	3.17	1.24	3.17	5.35
荷爾蒙處理與否	1	3.61	3.61	1.42	5.12	10.56
荷爾蒙間	8	24.87	3.11	1.22	3.23	5.46
機差	9	22.91	2.55			
總數	19	56.69				

(6) 6 月份嫁接後幼芽生長高度分析結果如表十七：

表十七 6 月份嫁接後幼芽生長高度分析表

變因	自由度	平方和	均方和	實際 F 值	理論 F 值	
					5 %	1 %
重複	1	0.03	0.03	0.78	5.12	10.56
處理	(9)	0.41	0.05	1.12	3.17	5.35
荷爾蒙處理與否	1	0.05	0.05	1.22	5.12	10.56
荷爾蒙間	8	0.36	0.05	1.10	3.23	5.46
機差	9	0.37	0.04			
總數	19	0.81				

3. 接枝切面癒合情形

接枝切面癒合情形就每株檢查結果，對照不用植物荷爾蒙處理者成活株接木部雖已癒合，但癒合組織 (callus) 之形成頗弱，且枯死株接木部接穗經剝開檢查結果切面大半腐爛毫無癒合組織形成痕跡。

採用植物荷爾蒙處理者成活株接木部癒合甚佳，就中 IB、NA 高濃度處理者癒合組織形成最旺切面癒合組織外溢至外部，枯死株將接穗剝開檢查結果，大部份已形成癒合組織，接穗切面仍保綠色之原狀，不易與砧木脫離。

四、結論及討論

由本試驗分析結果，接穗以應用植物荷爾蒙處理後，對柑桔接木切面癒合能力研究如下：

1. 應用植物荷爾蒙對成活率與氣候之影響：以周年之嫁接成活率觀察因 2 月份氣候溫暖樹液開始流動採用接穗（第二次發芽）已成熟，故成活率為最高。12月份處理者採用接穗（第一次夏芽）雖已成熟，但氣候寒冷其接木切面癒合受影響成活率次之，8 月份處理者因陽光强，照射時間長且氣溫高，雖採用接穗（春枝）已成熟，但因不耐長久陽光之照射，雖有處理其接穗乃不免有枯乾之現象，其成活率在其次。10月份處理雖氣候溫暖但接穗（第一次夏芽）組織未成熟之故，成活率低。6 月份處理因氣溫漸高採用接穗（春枝）亦未成熟，成活率甚低。4 月份處理氣候雖略適宜，但採用接穗（秋芽）組織嫩柔不飽滿，故成活率最低。

本試驗中接穗應用植物荷爾蒙處理與一般對照者比較，8 月、12月、2 月、4 月等時期以成熟枝條為接穗嫁接時因對照者之成活率平均值相當高而不易現出植物荷爾蒙處理之功效。10月及 6 月

等採用未成熟枝條，行嫁接時植物荷爾蒙處理者可促進未成熟接穗切面之細胞分裂，增加切面癒合能力，較對照區成活率均較高，但植物荷爾蒙之藥效依季節而不同。10月間之溫冷季節以NA50及100ppm 濃度者為優，（200ppm 高濃度者似有阻害切面癒合之現象），IB50 及 200ppm 次之，IA 之功效較差。6月間之高熱季節以 IB100 及 200ppm 濃度者為最佳，IA及NA 兩種均感有遜色。

2. 應用植物荷爾蒙對初期幼芽生長高度之影響，嫁接後初期生長高度與後期幼芽之生長高度不同，因成活株中未發芽者佔甚多，故以總成活株及總芽長求每株平均芽長時，與成活率間易發生負相關關係而現出甚大指數之差異。但經變方分析結果各植物荷爾蒙處理間及荷爾蒙處理與對照區間均無顯著差異，得知植物荷爾蒙處理對嫁接後一個月以內之幼芽發生及生長情形並無顯著功效。

3. 應用植物荷爾蒙對切面癒合組織形成之影響：接木切面癒合情形就每株檢查結果，接穗應用植物荷爾蒙處理者成活株接木部癒合甚佳，接穗切面癒合組織 (Callus) 之形成最旺，就中 IB、NA 高濃度處理者切面癒合組織有外溢現象。嫁接未成活之植株其接穗雖枯乾，但接木部大部份已形成癒合組織，其接穗切面仍保綠色原狀而不易與砧木脫離，故知植物荷爾蒙對接穗切面癒合能力確有攻效，若外界因子（溫度、濕度）可以控制至接穗發芽，則周年可提高嫁接成活率。

五、摘　　要

本試驗從民國52年7月起至民國53年6月止計一年，其目的在應用植物生長荷爾蒙刺戟柑桔接枝切面細胞促進其分裂，增强癒合能力，以探求柑桔嫁接之週年成活問題，本試驗採用 β-Indoleacetic acid, β-Indolebutyric acid α-Naphthaleneacetic acid各分為50，100，200ppm 濃度，於8、10、12、2、4及6月之六次施行嫁接，嫁接後一個月打開包紮物檢查成活率初期生長高度及切面癒合情形等，與對照不應用植物荷爾蒙者比較。

1. 週年之成活率而觀：8月（春芽）12月（第一次夏芽）2月（第二次夏芽）及4月（秋、冬芽）等時期，以接穗成熟者接木時，因對照者之成活率亦高，植物荷爾蒙處理區與對照區間無法求出顯著之差異。

2. 就10月（第一夏芽）及6月（春芽）等接穗未成熟時期之接木而言，植物荷爾蒙對組織嫩柔接穗在枯乾或萎凋以前，可促進接枝切面創傷細胞分裂，致接穗、砧木切面迅速癒合，確有增高成活率之功效。其功效依季節及植物荷爾蒙之種類而不同，10月間之溫冷季節以NA50，100ppm 濃度者為優，IB50，200ppm 濃度者次之，IA之功效最差，與對照區間並無差異。6月間之高熱季節以 IB100，200ppm 濃度者為佳，IA、NA兩種均感有遜色。

3. 未成活者將接木部檢查結果，植物荷爾蒙處理者均已完成癒合組織與對照之接穗切面部份腐爛者有明顯之差異，得知植物荷爾蒙對接枝切面癒合能力確有功效，若外界因子（溫度、雨量）等因子可控制，對柑桔嫁接成活仍有貢獻。

4. 初期幼芽之萠出及伸長而看，在嫁接後一個月之短時間內各處理間及應用植物荷爾蒙處理與對照區間並無顯著之差異。

EXPERIMENT ON CITRUS GRAFTING USING PIANT HORMONES
II. THE EFFECT OF PLANT HORMONES ON CALLUSING OF CITRUS GRAFTING

by

J. L. WENG

SUMMARY

This experiment was carried out in the Department of Horticulture of Taiwan Agricultural Research Institute from July 1963 to June 1964. The purpose of this experiment was to promote the ability of callus on the part of grafting and to increase the percentage of take after citrus grafting by using plant hormone all the year round. The kinds of plant hormones used were: β-Indoleacetic acid (IA), β-Indolebutyric acid (IB) and α-Naphthaleneacetic acid (NA), and all of them had the same concentration of 50, 100 and 200 ppm. The grafting was held every two months from June 1963 to June 1964.

The results may be summarizen as follows:

1. As a whole, the buds of Augest (spring bud), December (first summer bud), February (second summer bud) and April (autumn and winter bud) grew very strong, the percentage of take of the check was also high, so there was little difference among the treatments and the cheak.

2. The buds of October (first summer bud) and June (spring bud) grew weak, but plant hormones stimulated the wound-cell of the part of grafting and promoted the percentage of take. The effect of pland hormones varied with different kinds of pland hormones and different seasons. At a cool season, such as in October, the NA of 50 and 100 ppm were better. At a hot season as June, the IB of 100 and 200 ppm were better.

3. The plants which failed in plant hormone treating completed the callus at the grafting part, but the plants of the check rotted at the grafting part. So it make a big difference between the treatments and the check. If the humidity and the rainfall would be controlled, the plant hormone would offer more to promote the percentage of take.

4. At the very beginning of budding and extending, there was no evident difference between the treatments and the check.

各種藥劑打破雲南大頭菜種子休眠之研究

李 伯 年　　諶 靜 吾

雲南大頭菜爲蕓苔屬 (Genus Brassica) 芥菜羣 (Brassica juncea, Cosson) 之一變種，染色體數爲N＝18，性喜冷凉氣候，耐寒性能甚强，種子成熟採收後，因氣溫昇高，即進入休眠期，在高溫中不發芽，此種休眠期全部停止，須經 60～75 天。民國五十年六月二十八日在海拔 2,200公尺之福壽山農場採收之種子，拿到平地即進入休眠，自然氣溫下發芽不及10%，經用各種藥劑不同濃度，以及低溫處理，和產地對照，所得成績分述如下：

1　奇特靈 (Gibberellin) 處理之成績——奇特靈處理之濃度分成50，100，150，200PPM，於處理後三天開始發芽，至第四、五天發芽最多，滿十天結束，各濃度處理間之發芽率相差甚微，均達93%以上。

2　硫尿 (Thiourea) 處理之成績——硫尿處理之濃度分成 1000，1500，2000，2500PPM，於處理翌日即開始陸續發芽，至第三日發芽最多，以後又漸次降低，滿十天結束，各濃度處理間之發芽率差異甚大，1000PPM僅10%，1500PPM 爲33%，2000PPM 爲68.5%，2500PPM爲59%。

3　硝酸鉀 (Potassium Nitrate) 處理之成績——硝酸鉀處理之濃度分成1000，1500，2000，2500PPM，處理後滿十天，2500PPM者僅24%發芽率，其餘各處理均不滿10%，反不及室溫發芽率之高。

4　硫氰銨(Ammouinim Thiocyanate) 處理之成績——硫氰銨處理之濃度分成 1000，2000，4000，8000PPM，處理後滿十天，1000PPM 僅2%發芽，其餘各濃度全不發芽，可能濃度太高，種子生理受害之故。

5　增收素(Bene Plant) 處理之成績——增收素處理之濃度分成2000，3000，6000，10000倍，處理後滿十天陸續發芽，參差不齊，數量極微，2000倍30%發芽，3000倍 9%發芽，6000倍 16%，10000倍18%發芽。

6　愛多收 (Atonik) 處理之成績——愛多收處理濃度分成2000，3000，6000，10000 倍，處理後滿十天陸續發芽，情形和增多收相似，各種濃度之發芽率均在18%前後。

7　低溫處理——分成 10°C、15°C、20°C三種溫度，處理後第三天 10°C，15°C即達 80%以上之發芽率；20°C略嫌溫度太高，至第三天祇有57%發芽率，滿十天後 10°C，15°C可達90%以上之發芽率，20°C僅 72%之發芽率。

8　室溫處理——室溫處理，試驗當時之日夜平均溫度爲 28.8°C，滿十天之發芽率爲12%。

9　產地對照——產地位於臺中縣和平鄉梨山福壽山農場，海拔 2,200 公尺，夏季無高溫，非常凉爽，七月間之平均溫度爲 17°C，以六月二十八日收穫之種子，經十五天做發芽試驗，其發芽率高達 99.5%。

玆將各種藥劑處理之成績列表如下；

各種處理對於種子發芽之情形

Germination of the Seeds With Different Treatments

處理別 Treatments		試驗日期 Date of seeding	每日發芽數 Days after seeding 1	2	3	4	5	6	7	8	9	總計 Total	發芽率 % of germination
奇特靈 Gibberellin	50 ppm	7月7日 July 7	0	0	3.5	31.5	50.5	5.0	2.5	0	0	93.0	93.0
	100 ppm		0	0	3.0	38.5	46.5	6.0	1.0	0	0	95.0	95.0
	150 ppm		0	0	2.5	22.5	35.5	30.5	4.0	0	0	95.0	95.0
	200 ppm		0	0	4.0	27.5	34.0	27.0	2.0	0	0	94.5	94.5
硫尿 Thiourea	1,000ppm	7月7日 July 7	0.5	3.0	1.5	2.0	3.0	0	0	0	0	10.0	10.0
	1,500ppm		9.5	11.5	1.0	2.5	6.0	1.0	1.5	0	0	33.0	33.0
	2,000ppm		14.0	24.5	13.0	10.5	4.5	0.5	1.0	0.5	0	68.5	68.5
	2,500ppm		8.5	16.5	5.5	6.0	22.5	0	0	0	0	59.0	59.0
硝酸鉀 Potassium Nitrate	1,000ppm	7月7日 July 7	0	0	1.0	3.0	1.0	0	0	0.5	0.5	6.0	6.0
	1,500ppm		0.5	0.5	1.5	1.0	2.0	1.0	0	0	0	6.5	6.5
	2,000ppm		0	0.5	1.0	1.0	1.0	4.0	1.5	0.5	0	9.5	9.5
	2,500ppm		0.5	0	0	1.0	2.5	3.0	6.5	9.5	1.0	24.0	24.0
硫氰銨 Ammonium Thiocyanate	1,000ppm	7月7日 July 7	0	0	0	0	0.5	0.5	0.5	0	0.5	2.0	2.0
	2,000ppm		0	0	0	0	0	0	0	0	0	0	0
	4,000ppm		0	0	0	0	0	0	0	0	0	0	0
	8,000ppm		0	0	0	0	0	0	0	0	0	0	0
增收素 Bene plant	1/2,000	7月7日 July 7	0	1.0	10.0	6.0	1.0	3.0	5.0	3.0	1.0	30.0	30.0
	1/3,000		0	0	2.0	0	0	6.0	0	0	1.0	9.0	9.0
	1/6,000		1.0	0	3.0	4.0	2.0	1.0	4.0	0	1.0	16.0	16.0
	1/10,000		1.0	1.0	2.0	1.0	0	5.0	4.0	2.0	0	18.0	18.0
愛多收 Atonik	1/2,000	7月7日 July 7	1.0	0	3.0	1.0	0	5.0	4.0	4.0	0	18.0	18.0
	1/3,000		1.0	3.0	7.0	3.0	1.0	0	1.0	0	0	16.0	16.0
	1/6,000		1.0	1.0	8.0	4.0	1.0	1.0	2.0	0	0	18.0	18.0
	1/10,000		3.0	3.0	2.0	2.0	4.0	1.0	2.0	1.0	0	18.0	18.0
低溫處理 Low temperature treatments	10°C	7月6日 July 6	0	0	80.0	5.0	4.0	2.0	0	0	0	91.0	91.0
	15°C		0	0	85.0	10.0	3.0	0	0	0	0	98.0	98.0
	20°C		0	0	57.0	12.0	2.0	1.0	0	0	0	72.0	72.0
室溫處理 Natural temperature	28.8°C	7月7日 July 7	0	0	1.0	2.0	6.0	2.0	1.0	0	0	12.0	12.0
產地對照 Check	17°C	7月15日 July 15	—	—	—	—	—	—	—	—	—	—	99.5

據上各項處理成績之分析，雲南大頭菜種子之休眠，受環境因素之關係甚大，在產地因收穫後，沒有高溫，故休眠期甚短，收穫後之種子，隨即播種，仍可立即發芽，且發芽率高達 99.5%。如收穫後之種子，携至平地，因氣溫突然昇高，和產地相差達 10°C 以上，可能因環境不適，即進入休眠期，發芽數字極微，此項休眠之打破，應用 10°C，15°C 低溫處理三天，可促進發芽率達90%

以上，應用(Gibberellin)50—200PPM處理，亦可達到93%以上之發芽率；其次硫尿(Thiourea) 2000PPM可促進發芽率68.5%；至於硝酸鉀(Potassium)，硫酸錏(Ammonium Thiocyanate)，增收素(Bene Plant)，愛多收(Atonik)打破休眠之效能不大。

EXPERIMENT ON BREAKING THE DORMANT SEEDS OF *BRASSICA JUNCEA* COSS. *VAR. MEGARRHIZA* TSEN ET LEE

by

P. N. Lee and C. W. Shen

SUMMARY

The newly harvested seeds of *Brassica juncea var. megarrhiza* usually enter into the dormant stage under high temperature. Then we can not expect the germination of such seeds during the dormant stage unless we use artificial methods such as low temperature or chemical treatment to break dormancy.

In this experiment, we studied out the effects of low temperature or some chemicals including commercial plant growth substances on the dormant seeds of *Brassica juncea var. megarrhiza.* All the tested seeds were sown in petri dishes.

From the data obtained, we can see that all low temperature treatments (10°C and 15°C) and gibberellin treatments (50–200 p. p. m.) showed excellent results on breaking dormancy of the seeds. The percentage of germination exceeded 91 percent. The effects of other chemicals were low, but 2,000 p. p. m. thiourea treatment was rather satisfactory.

澎湖紅棕壤之化育的研究[1]

梁 鉅 榮　黎 靜 韻[2]

一、前　　言

澎湖縣之土壤計有二土系（1，2）一為澎湖系，由玄武岩化育而成；一為花嶼系，由玢岩或石英玢岩化育而成，就面積言，以前者為廣，後者僅占花嶼一小島耳，本研究原應選取二土系之代表樣本，進行粘土礦物成分之研究，以為該二土系化育作進一步之研討，後以檢查庫存樣本，澎湖系之原樣盒形剖面標本，經已散失，本研究須於半年內完成，因僅就存有之花嶼系完整代表剖面樣本進行其粘土礦物成分之分析，以為從新作該系土壤化育的檢討根據，花嶼系土壤化育於大海中約一方公里之花嶼小島，四面環海、氣候、植物、地形及地質年代與其他澎湖羣島六十三島環境相同，僅其成土之母質或岩石不同，因另成一土系，該土系之化育研究，不因面積狹小而影響其資材價值，且正可作其他亞熱帶海上島嶼之具不同母質者作土壤化育之比較參考，此本研究之緣起亦其目的也。

二、澎湖花嶼系粘土礦物成分之研究

1. 供試之土樣簡述

花嶼系之完整剖面原形態敍述(2)係分三層，玆為加强研究起見，從新分五層採樣，以供分析，現補述分層之厚度及其各層之形態於下：

0——10公分	乾時黃紅色(5yR$^5/_8$)，潤時紅色（2.5yR$^4/_6$）之粘土，夾有石塊，小團粒或塊狀構造，團塊壓之多碎成核粒，潤時結構微實，濕時具粘結性與可塑性，裂隙頗多，有植物根穿透土內，通透性中等，有機質少，無石灰性反應，pH6.0。
10——30公分	乾時紅黃色（5yR$^6/_6$），潤時紅色（2.5yR$^4/_8$）之粘土，核狀或塊狀構造，潤時結構堅實，仍多裂隙，濕時具强粘結性與可塑性，土內通透性不良，有機質更少，無石灰反應，pH6.0。
30——50公分	紅黃色（5yR$^6/_6$乾）至紅色（2.5yR$^5/_6$潤）粘土，pH6.1，餘同上層。
50——75公分	强棕色（7.5yR$^5/_6$乾）至黃紅色（5yR$^5/_6$潤）粘土，pH6.0，餘同上層。
75—120公分	紅黃色（7.5yR$^6/_6$乾）或（5yR$^6/_6$潤）粘土，間有紅斑紋，濕時無構造，呈弱粘結狀態，有機質極少，無石灰性反應，pH6.0。
120 公分以下	黃白色半風化之玢岩，壓之易碎裂開。

2. 試驗之項目及方法

(1) 粘粒之分離：

應用 IN.Na_2EDTA 為分散劑，與供試土壤放於瓶中，放置於搖土機上，振盪四小時，分散其粒子，取出後使其通過 300 號篩，以去除其粗粒部份，將土液加入 30%H_2O_2 除去其有機質，然後在蒸氣水鍋上作用數次蒸乾，加水使再分散，續於搖土機振盪一小時，取出，調整其 pH 至 9，傾於 1,000ml 量筒內，應用土粒沉降速度理論（8）計算時間，以分離（$<2\mu$）以下之粘粒，重覆四次，收集其粘粒懸浮液貯於大玻璃瓶內，以備各項分析之用。

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(1)本研究工作，荷承國家長期發展科學委員會之補助。

(2)本研究之 X-ray 照片分析，D.T.A. 分析，及 T.G.A. 分析，係第一作者於五十二年夏在加州大學進修期間，假土壤系粘土礦物研究室完成，其餘項目及補充分析，均由第二作者於本所土壤室完成。

(2) 粘粒部分（<2μ）之粘土礦物成分之分析

由上分離之粘粒懸浮液，直接用以進行下列各項之分析：

a 濃度試驗：用以計算由該土液所進行之各項分析結果

b X-Ray 分析：Barshad氏修正鹽漿法(5)

c 陽離子交換能量試驗：Barshad 氏法(7)

d 游離鐵之分析：Barshad 氏法(7)

此外另須應用風乾土進行之分析，即另取大部懸浮液，應用素瓷吸濾器濃縮之，並於蒸氣水鍋上蒸乾之，然後置於室內風乾數日，以為進行下列諸項之分析。

e 示熱差分析 (Differential thermal analysis):Barshad 法(6)

f 熱重量分析 (Thermal gravimetric analysis):Barshad 法(6)

g 全鉀量分析：用 X-ray Fluorescene 分析

3. 試驗結果

由上數分析項目所得之結果，可分兩點說明：一為關於研究之粘土物質定性的鑑別，另一為此種粘土礦物量之測定。

(1) 粘土礦物的鑑別

a. X-Ray 分析：

X-Ray 分析之結果如附圖1,2,3,4及5，綜合其特徵如表1並說明如下：

表1 花嶼粘土 X-Ray 照片概略說明

Table 1. Interplaner Spacing and Estimated Intensities in X-ray Powder Diagram of Glyceral-wet <2μ Clay of Hwa-yu Clay

Spacing Å	處理	10.09	7.16	5.01	4.48	3.58	3.35
Name of Minerals	Treatment	Muscovite	Kaolinite	2nd line of Mus.	Common in all	2nd line of Kao.	3rd line of Mus.
Sampling No.		強度 Intensities					
16-1	room temp. °C	m	vs	w	s	vs	s
16-1	400 °C	s	vs	w	s	s	ms
16-2	room temp. °C	m	vs	vw	s	vs	s
16-2	400 °C	s	s	vw	s	s	s
16-2	570 °C	s	—	vw	s	—	m
16-3	room temp. °C	m	vs	w	s	vs	s
16-3	400 °C	s	s	w	s	vs	s
16-4	room temp. °C	w	vs	w	s	vs	s
16-4	400 °C	s	s	w	s	vs	s
16-5	room temp. °C	w	s	w	s	vs	s
16-5	400 °C	s	vw	m	s	—	s
16-5	570 °C	s	—	m	s	—	s

vs.極強，s.強，m.中等，w.弱，vw.極弱

本項分析結果，自圖 1,2,3,4 及 5 照片之觀察及量度結晶內格距離 Å 之結果（見表1），至易鑑別兩種礦物之存在，如表1所示，Kaolinite 顯示於 7.16Å，4.48Å 及 3.58Åd (001) 之結晶內格

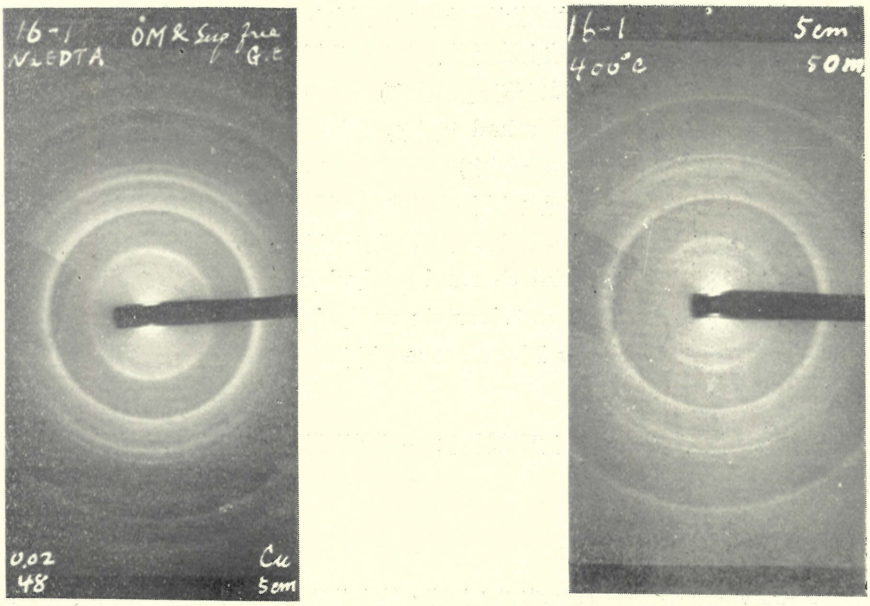

圖１：花嶼粘土剖面第一層之X-ray 照片

Fig. 1 X-ray photographies of the 1st. lazer of Hwa-yu clay

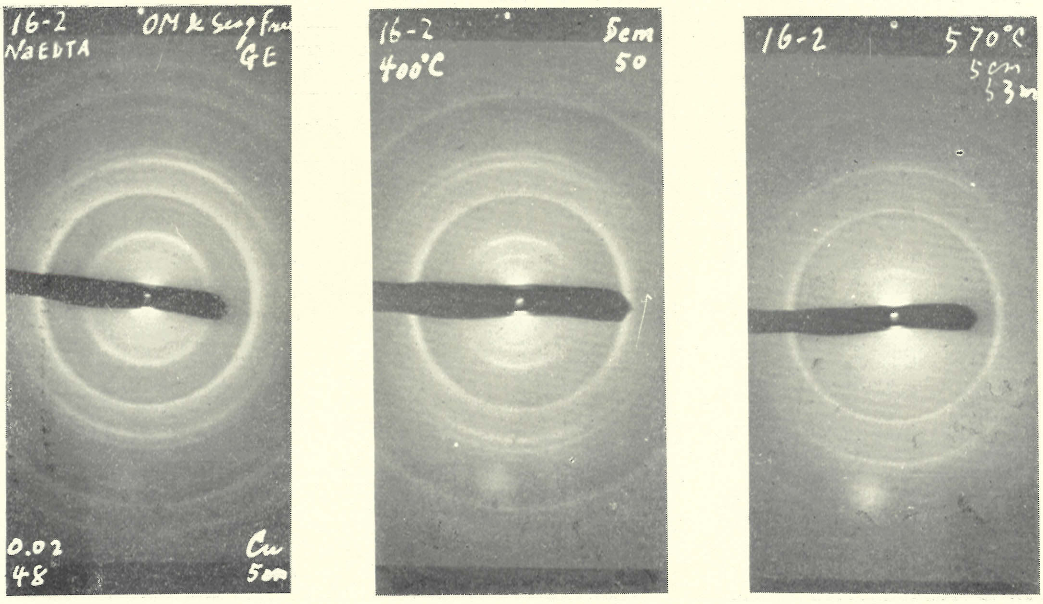

圖２：花嶼粘土剖面第二層之X-ray 照片

Fig. 2 X-ray photographies of the 2nd. lazer of Hwa-yu clay

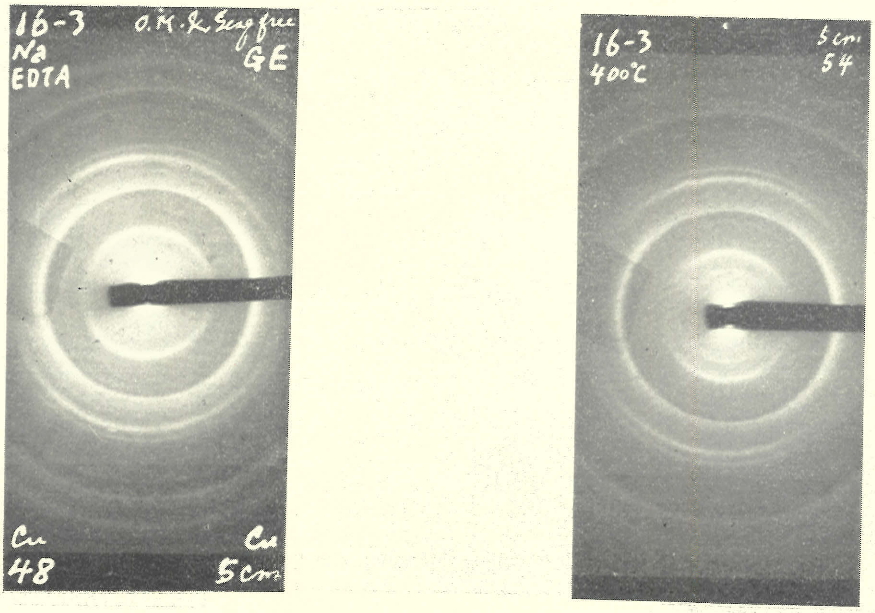

圖 3 ：花嶼粘土剖面第三層之X-ray 照片

Fig. 3 X-ray photographies of the 3rd. lazer of Hwa-yu clay

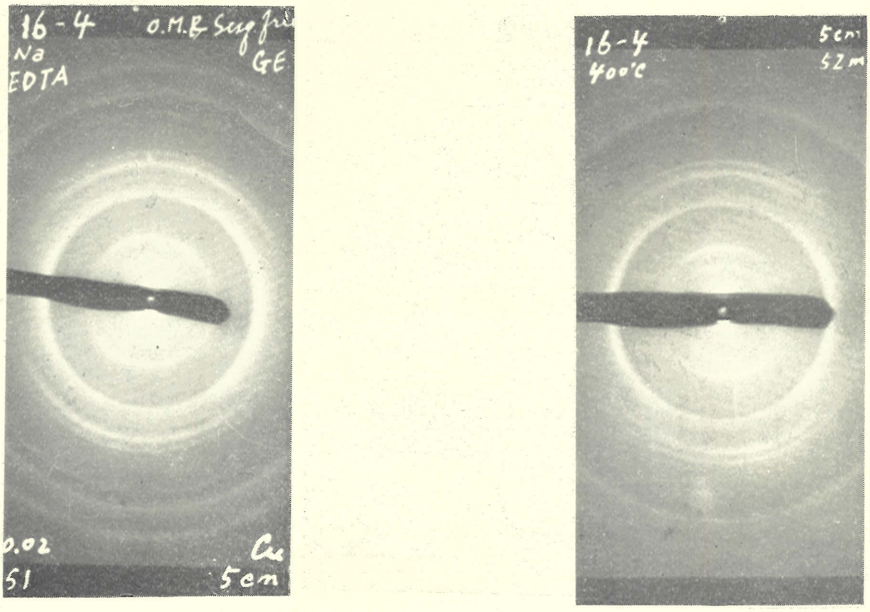

圖 4 ：花嶼粘土剖面第四層之X-ray 照片

Fig. 4 X-ray photograhpies of the 4th. lazer of Hwa-yu clay

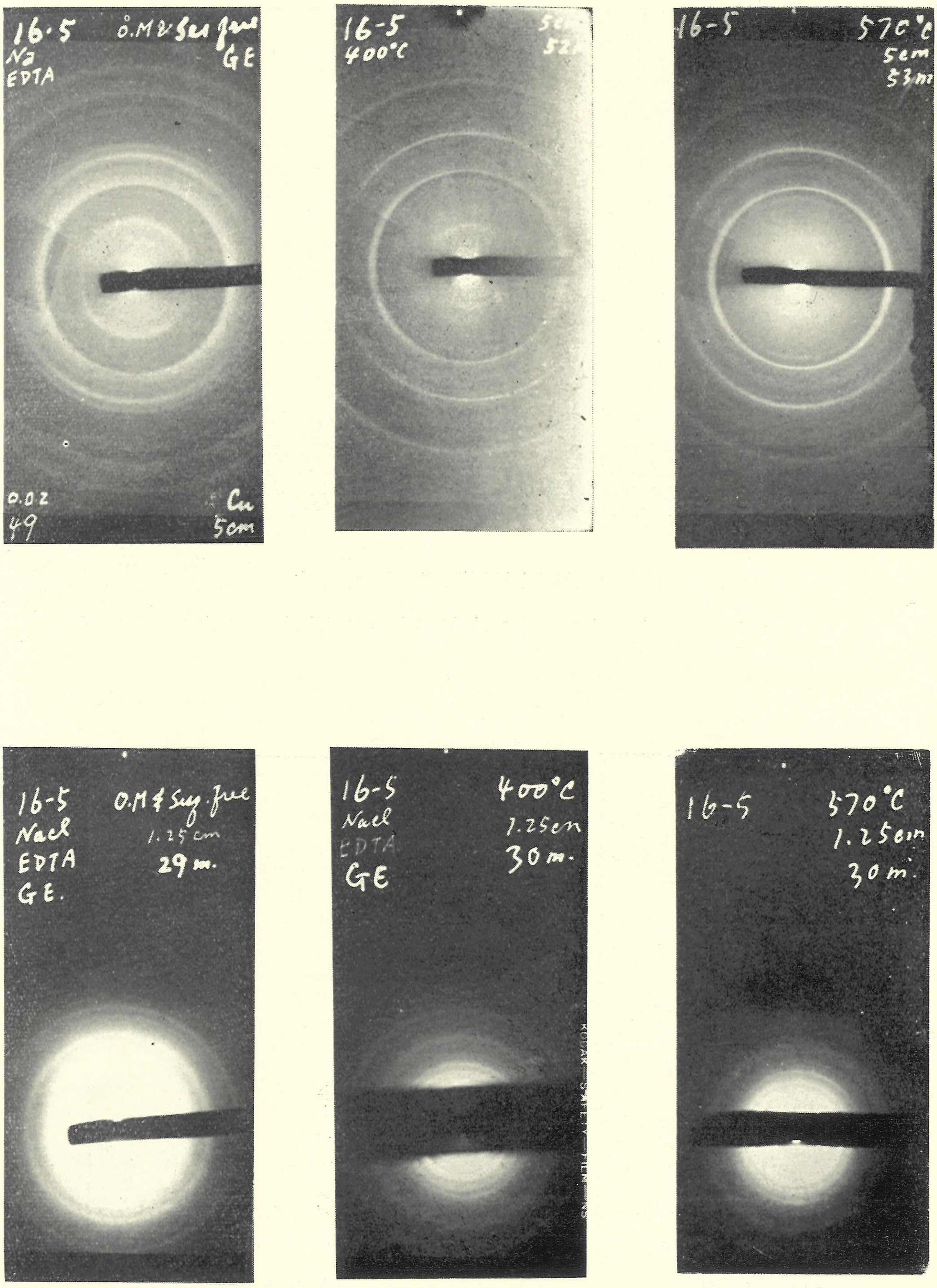

圖5：花嶼粘土剖面第五層X-ray 照片

Fig. 5 X-ray photographies of the 5th. lazer of Hwa-yu clay

距離，Muscovite 或 mica 顯示於 10.09 Å，5.00 Å 及3.35 Åd (001)之結晶內格距離，故其鑑別至爲顯然。

由於 5.00Å 之强度相當顯，即示 dioctahedral mica 或 Muscovite 之存在。

b 示熱差 Differential Thermal analysis 分析

示熱差分析之結果，如圖 6 及 7 所示，前者爲數種標準礦物之示熱差曲線，後者爲花嶼粘土代表剖面五層之示熱差曲線，照此曲線之V形對稱形態相當明顯，及其內熱破面開始於約 455°C 並終止於約600°C左右 (7，14) ，核與圖 6 之 Kaolinite 標準曲線，至爲符合，更足證明 Kaolinite 之存在。

16—1 與 16—2 兩土層之 DTA 曲線在 300°C 左右有輕微之內熱破面出現，表示有少量 Gibbsite 之存在，(7，14)其他三層則僅痕跡或甚無之

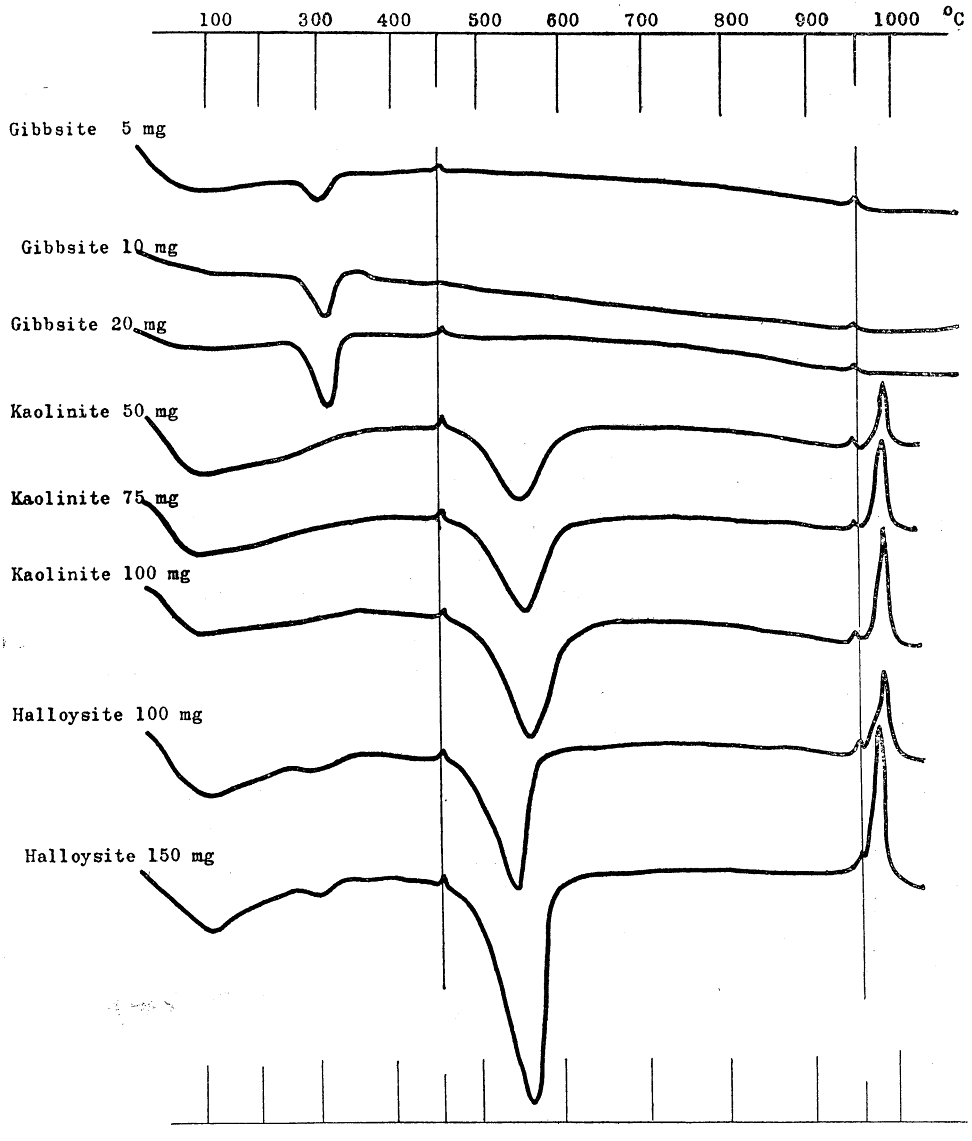

圖 6 數種純礦物不同數量之示熱差曲機

Fig. 6 D. T. A. CURVES OF SOME PURE MINERALS IN DIFFERENT QUANTITIES

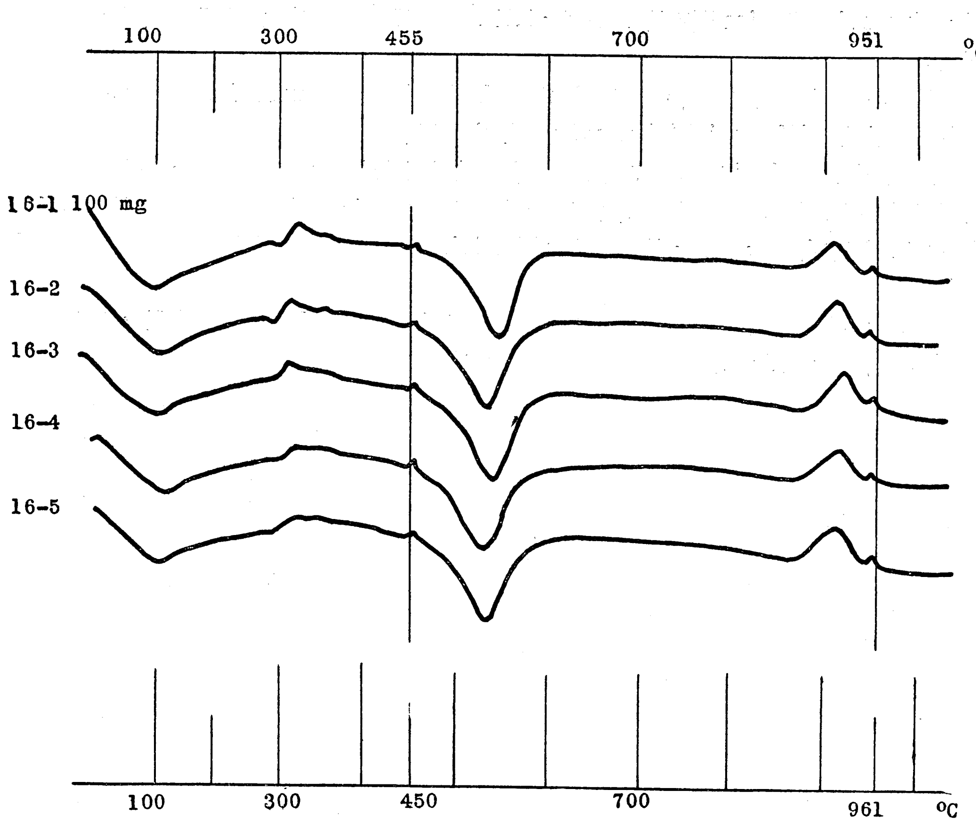

圖7：花嶼粘土剖面各層之示熱差曲綫

Fig. 7 D. T. A. CURVES OF HWA-YU CLAY OF PENGHU HSIEN, TAIWAN, CHINA

c 熱重量分析 Thermal gravimetric analysis 本項分析結果如表 2 。

表二 熱重量分析結果 (%)

Table 2. Result of Thermal Gravimetric Analysis

土 號 Soil number	厚 度 Depth cm.	吸 收 水 分 Absorbed water		Loss between 180—325°C	Loss between 325—1000°C	結晶水分 Total crystal water
		180°C basis	ignited basis	燃	灼 土 Ignited basis	計
16-1	0-10	4.3	4.83	2.44	10.22	12.66
16-2	10-30	3.73	4.21	2.40	10.63	13.03
16-3	30-50	4.8	4.58	2.23	10.62	12.85
16-4	50-75	3.66	4.16	1.97	10.64	12.71
16-5	75-120	3.74	4.19	1.50	10.82	12.32

本項分析由於將樣本加熱至 180°C，325°C 及 1,000°C 應用以求出其吸收水分及結晶格子水分，粘土礦物根據其結晶格子水分之量可以顯然的分成兩大類(6)

I. 吸收水分在低溫時損失至 20 %，結晶格子水分在高溫時損失少於 5 %，指出2：1 礦物之存在。

II. 在低溫損失水分少於 5 %，在高溫損失水分多於 12 %，指出1：1或2：2礦物之存在。

III. 在低溫損失水分在10與15%之間，在高溫損失水分少於 2%，指出 Allophane 之存在。

由表 2 知花嶼粘土各層之粘粒，在低溫損失水分 4.2—4.8 %，在高溫損失水分均在 12.3—13%

，指示該粘上具 1：1 類或 2：2 類之礦物之存在，更說明該粘土並無 Allophane 之存在。

b　化學分析

化學分析之結果如表 3

表三　花嶼粘土之粘土部份（<2μ）之化學補充分析（1,000°C）

Table 3. The supplemental chemical analysis of the clay fraction (<2μ) of Hwa-yu clay (ignited basis)

土號 Soil number	厚度 Depth cm.	K_2O %	游離鐵 Free Fe_2O_3 %	陽離子交換能量 C.E.C. m.e./100	pH
16-1	0- 10	2.11	11.4	26.4	6.0
16-2	10- 30	1.96	10.7	20.6	6.0
16-3	30- 50	2.08	10.4	25.1	6.1
16-4	50- 75	2.36	10.0	23.6	6.0
16-5	75-120	2.49	9.3	28.9	6.0

c　機械成分之分析

應用 Na_2E.D.T.A 爲分散劑，進行之機械分析結果如下表

表四　花嶼粘土之機械成分（%105°C）

Table 4. The mechenical composition of Hwa-yu clay (%105°C)

土號 Soil No.	厚度 Depth cm.	砂粒 Sand 2-0.02m.m.	坋粒 Silt 0.02-0.002m.m.	粘粒 Clay<0.002m.m.	質地名稱 Name of texture
16-1	0- 10	8.57	26.09	65.34	粘　土
16-2	10- 30	6.07	25.58	68.35	〃
16-3	30- 50	3.50	25.65	70.85	〃
16-4	50- 75	3.50	30.77	65.73	〃
16-5	75-120	3.35	36.40	60.25	〃

(2)　粘土礦物之量的測定

土壤粘土礦物成分之測定，在根據數種性質測定下較爲可靠，本研究花嶼粘土之結果，由 X-Ray 照片分析，指出 Muscovite, 及 kaolinite 之存在，由 DTA 分析，從其曲線更證明該土各層粘粒均有 kaolinite 之存在，且在第一，第二層有微量之 Gibbsite，此三種粘土礦物之量的測定，可分述如下：

Muscovite 之含量，根據純礦物 Muscovite 約含有10%之 K_2O，故可由粘粒中 K_2O 之含量以推算之。

Kaolinite 之含量，從照片結晶內格之距離 7Å 之强度，可推想其含有量頗豐富，再應用求積器量度標準 Kaolinite 示熱差曲線之內熱破面範圍之面積，繪成標準 Kaolinite 數量曲線，應用之以比較花嶼粘土之 DTA Kaolinte 之內熱破面，可計算其百分數。

至於 Gibbsite 之求出，可根據熱重量分析之結果，間接由結晶水重與陽離子交換能量以計算之（見下例），由是花嶼粘土之粘粒部份之礦物成份結果如表 5 。

以下爲計算該 Gibbsite 之方法之實例：前述分析結果由表 1 及圖 7 查出 16—1 鈉飽和粘土含有 Muscovite, Kaolinite 與 Gibbsite。從熱重量分析結果表 2，更證實該粘粒具有1：1或2：2類礦物之存在，全結晶水之損失爲 12.66，由示熱差分析知該土樣含有Kaolinite 60%，K_2O 之分析結果爲 2.11 %，換算 Muscovite 爲 21.1 %。C.E.C. 爲 26.4m.e./100，故設 y 係該樣本之

Gibbsite 含量，則可根據下列關係計算之(6)

表五　花嶼粘土之粘土礦物成分表（燃灼土計%）

Table 5. The clay mineral composition of Hwa-yu clay (ignited basis%)

土號 Soil No.	厚度 Depth cm.	Kaolinite	Muscovite	Gibbsite	游離鐵 Free Fe_2O_3	其他 Others
16-1	0- 10	60.0	21.1	2.8	11.4	4.7
16-2	10- 30	59.8	19.6	3.8	10.7	6.1
16-3	30- 50	59.9	20.8	Trace	10.4	8.9
16-4	50- 75	59.6	23.6	—	10.0	6.8
16-5	75-120	60.0	24.9	—	9.3	5.8

礦物名稱	結晶水%	吸收水%	C.E.C.m.e./100
Kaolinite	16.20	——	——
Muscovite	0.45	4.74	30
Gibbsite	52.95	——	——

考慮及此，則可列出如下之關係式：

$$\frac{60\times16.20}{100}+\frac{21.\ \times\ (0.45+4.74+18\times0.03)}{100}+\frac{y\times52.95}{100}=12.66-\frac{1}{2}(0.0264\times18)$$

解上式則　　$y=2.81\%$

依上計算方式，可求出第二層之 Gibbsite，如表5所列。

總而言之，花嶼粘粒部份之粘土礦物成份，以 Kaolinite 爲主要成分，各層間之差異不顯，約在60%，其次則爲 Muscovite，約在 20 %，Gibbsite 僅第一、二層發現約爲 3 %， Fe_2O_3 各層均約含 10 %。

三、過去對花嶼粘土之研究

1. 郭魁士先生對花嶼粘土之見解：(1)

郭先生從岩石之風化，就花嶼系之玢或石英玢岩之成分，及其分解後之可能發展，論列其風化程度較由玄武岩生成之澎湖系爲深，至於成土方式，則認爲似有紅壤化作用之進行趨勢，而發育成爲幼稚之紅壤，玆摘錄其見解於下：

『花嶼系土壤由玢岩發育而成，玢岩近乎酸性火成岩，礦物主爲斜長石，角閃石及石英等，斜長石爲含鈉較多偏於酸性者，與玄武岩所含之斜長石有別，分解後多變爲高嶺土，角閃石爲鐵、銻、鈣、鎂等之亞矽酸鹽，分解後變爲綠泥石，有磁鐵礦析出，石英仍以原粒狀分佈於土壤中，由此生成之土壤含矽酸必較高，（據分析結果，SiO_2 之含量均在50%以上）鐵鋁亦不少，銻鎂可能較少，而一價離子必較多，鉀鈉等鹽類較鈣鎂易流失，土壤之 pH 值必較低。

就風化之程度而言，風化層之深度亦淺，多不及一公尺，此亦因風之侵蝕作用，且因地勢傾斜，雨水之侵蝕亦烈，玢岩質地密緻，風化後產生粘性土壤，極少含有石礫，粘粒之成分較多，砂粒中多石英，風化之程度實較玄武岩爲深』

「花嶼系土壤發育於玢岩之上，風化程度較深，此酸性火成岩風化後，析出鈣鎂等鹽類較少，而易溶解之一價鹽基物質較多，降雨時化學的淋洗作用較旺盛，而水分上升蒸發時，鹽分之上升作用較輕微，似有紅壤化作用 (Laterization) 之進行趨勢，而發育成爲幼稚之紅壤。」

2. 席連之先生之推論(3)

席先生參考 Cline M.G 氏等調查夏威夷土壤之報告，比較澎湖與夏威夷之氣候，再根據花嶼

系土壤粘粒部份之矽鐵鋁率，認爲該土系應屬低腐殖紅壤，玆引述該論述於下：

「査本省所處之地理環境及農業利用情形，與夏威夷羣島頗多類似之處，其土壤亦可互相比擬，據美農部之 M.G. Cline 等氏調査夏威夷土壤之報告，該地各種主要土類之發育很與本省相似，其所謂「低腐殖紅壤 (Low-Humic Latosal) 一類，係發育於玄武岩或安山岩上，年雨量不足四十英吋，平均溫度在 23°C 左右，土壤呈紅棕，乃至棕色。pH6.0-7.0，矽鋁鐵率1.4左右，矽鋁率1.6—2.1間，本省澎湖縣之年雨量1,000 公厘，母質爲玄武岩，其花嶼系之pH値爲6.1—7.6，矽鋁鐵率爲1.42—1.65，矽鋁率1.84—2.09，與 Cline 氏所述之剖面性質極相似，應屬同一土類。」

3. 筆者於1950年，對花嶼粘土之見解：

1950年筆者發表之「澎湖之土壤」(2)其中對土壤化育方面有下列之總述：

「總之，卽在高溫，中雨，强風，蒸發量大於雨量，濕度仍相大之氣候環境下，土壤之成土作用，仍爲磚紅土化作用，惟因母質不同，磚紅土化作用進行有遲速，石英玢岩之紅土化（指花嶼系）較玄武岩之紅土化（指澎湖系）爲迅速，故前者化育較完善，而後者發育尙在幼稚期，由化學分析結果，可證明之。」

四、討　　論

花嶼系土壤之分類，前列擧三人之意見，雖略有出入，但均有相同之觀點，卽均認爲該系土壤屬紅壤類，惟紅壤之化育程度，則各人意見有別耳，郭氏以爲應屬幼稚之紅壤，席氏以爲應屬低腐殖紅壤，筆者稱爲紅棕壤，玆根據本研究粘土礦物及數補充理化性分析結果綜合討論之於下：

據 Tamura 等 1953 年研究夏威夷之低腐殖紅壤之礦物成分含量(16)以 Kaolin 爲顯著，在45—55% ，並有 Hematite 15—25 %，Allophane 5—10 %，及 Montmorin 5—15 %；又據 Sherman 等 1959 年之硏究(15)，「低腐殖紅壤化育於鹽基性結晶岩上，位於亞熱帶以至熱帶地區，在半乾燥以至半濕潤而有一顯著之乾燥時期之氣候下生成，土壤之剖面特徵，爲具有一弱之A層，而土體以 Kaolin 粘土爲顯著，而其化學及礦物之成分頗爲一致，粘粒部份之 Kaolin 超於 50%，與 Fe_2O_3 及少量之 Gibbsite 爲其特徵。」證之此次分析結果表5，就主要成份 Kaolinite 言，堪稱符合，至於次要成分如 Allophane 與 Montmorin 則花嶼粘土均缺，又 Hematite, 則由 Fe_2O_3 之結果尙未能斷其然否。玆再就形態與理化性比較於下：

據 Sherman 氏列擧低腐殖紅壤之 Molakai 系之代表剖面(15)敍述如下：

「A_1　0— 3吋　暗紅色玢質粘土，弱細片狀構造，潤時極脆性，濕時無塑性，與過氧化氫作用，生劇烈之氣泡。pH6.0—7.0

B_1　3—20吋　紅色玢質粘土，具極弱的粗稜狀構造，潤至乾時極脆性，濕時無塑性，餘同上層。

B_2　20—48吋　紅色玢質粘土，具弱的粗稜狀構造，潤至乾時極脆性，濕時有極微塑性，與 H_2O_2 作用生劇烈之氣泡。pH6.0—7.0

B_3　48—70吋　紅色玢質粘土，具中等之塊狀構造，且較上層實，潤時脆性，濕時微有塑性，其構造之粒團面染上深棕或黑色薄膜，與 H_2O_2 起泡沫作用，但粒團之內面則無。pH6.0—7.0

C　70吋以下　紅、灰或棕色之風化岩石，保存原來岩石之構造，並環繞未風化岩石中心。」

就剖面形態之記載，低腐殖紅壤之主要特徵，爲具有極脆性（潤時），或無塑性（濕時）之結構 (Consistence)，雖具粘重之質地者亦然，花嶼系之土壤具60%之粘粒，其結構濕時具强粘結性，潤時實而不脆，是爲與低腐殖紅壤相異者。

至於低腐殖紅壤之化學性質中 SiO_2/R_2O_3 爲 1.1—1.7，SiO_2/Al_2O_3 爲1.7—2.3，並有豐富之 MnO_2 含量，比較花嶼系之過去記錄，則 SiO_2/R_2O_3 與 SiO_2/Al_2O_3 在該範圍內，惟 MnO_2 僅有少量，故從形態，化學性及礦物性三方面比較之，花嶼系與夏威夷之低腐殖紅壤之特性多有未盡

相同處，由本研究之礦物分析更足證明之。

查紅壤化作用之量度，從礦物學觀點爲破壞 Kaolinite 以生成 Gibbsite 爲磚紅壤之最後產物 Gibbsite 愈多，紅壤化愈完善，最後變爲 Laterite，至於 Kaolinite 爲其中間之產物，2：1 類礦物爲其初期產物，故 Kaolinite 含量越豐，指紅壤化作用盛行，反之，旣無 Gibbsite 生成時，而 Kaolinite 亦不多，指該作用僅在初期。

據此以論斷花嶼系之土壤，指 Kaolinite 含量60％左右，表層有 Gibbsite 之存在，指其紅壤化作用非在初期已明。筆者前年赴美進修，專研本省紅棕壤十五代表剖面之粘土礦物成分，其 Kaolinite 最高30％，最低 13％，尙無一剖面之 Kaolinite 成分可與花嶼系者相比，亦即花嶼系之紅壤化作用較臺灣本島各處之磚紅壤作用尤强。

Merwe 氏等(13)研究南非洲磚紅化土壤之粘土礦物成分，結果與土壤形態分類至相符合，在排水良好與雨量豐富環境下，高度之風化作用進行，土壤膠體僅含 Kaolinite, Gibbsite 與 Fe_2O_3，在年雨量低於30英吋之地區，風化程度較遜，未分解之石英與雲母出現於膠體粒內，粘土礦物如 Illite, Gibbsite 亦相繼出現。

澎湖之雨量，雖爲本省最少之地區，第年雨量仍有988公厘，(2)接近 40 吋，因有相當高度磚紅化之花嶼粘土生成。

爲探求該剖面各層化育之區分，曾作各層物理性質之補充分析，其結果如表 6 。

縱觀表 6 分析結果，就該系各土層之物理性質如：容積重、孔度及機械成分之粘粒成分，在該剖面第五層有顯然與其上諸層截分之趨勢，證之化學成分及礦物成分 (Kaolinite 除外)亦趨一致。根據 Barshad 氏研究土壤化育區分層次之論斷(4)，該第五層卽自75公分以下可作爲該花嶼粘土之母質層核與形態之觀察，亦頗符合。

表六　花嶼粘土之物理性分析結果

Table 6. The physical properties of Hwa-yu clay

土號 Soil No.	厚度 Depth cm.	容積重 Volume weight	眞比重 Real density	孔度 Porosity %
16-1	0- 10	1.44	2.65	45.67
16-2	10- 30	1.50	2.65	43.40
16-3	30- 50	1.68	2.65	36.61
16-4	50- 75	1.75	2.65	33.97
16-5	75-120	1.50	2.65	43.40

據 Harrassowitz 氏 (11) 研究標準Laterite區分下列之層次

H. 腐殖土 (不常存在)

B_2 鐵結核

B_1 積聚層 (三氧化物)

A. 分解層 (水化鋁矽酸鹽)

C. 新鮮岩石

並非所有 Laterite 含有其全層次，間有層次缺少，三氧化物之積聚可以不生成結核，應試用 Harrassowitz 之理論，與 Barshad 氏之區分土層理論，以推論花嶼粘土剖面生成之層次，則應排列如下：

B_2	16——1	0—— 10	積聚層
B_1	16——2	10—— 30	
A_{12}	16——3	30—— 50	分解層
A_{11}	16——4	50—— 75	
C	16——5	75——120	C層

查上列分層與礦物及理化性分析結果，至爲符合。

五、結　　論

花嶼粘土位於大海上之一小島，當地之氣候年平均氣溫爲 22.6°C，年雨量 988 公厘，强風，蒸發量(1,820公厘)大於雨量，濕度仍相當高 (83%) 之大氣環境下生成，由粘土部份之化學成分，矽鐵鋁率 1.42—1.65，及矽鋁率 1.84—2.09，再證之粘土部份 ($<2\mu$) 之礦物成分，Kaolinite 在60%，第一、二層更具 Gibbsite 3%內外，且均較臺灣省其他紅棕壤之 Kaolinite 成分爲高，足可證明該系土壤磚紅土化作用相當高，從形態如土壤結構，乾時無脆性，濕時可塑性，與粘土礦物中含 Muscovite ，該花嶼粘土與夏威夷之低腐殖紅壤亦有別，在土壤分類上，仍以歸屬爲紅棕壤爲宜。

按照理化性及礦物性之分析結果，採用 Barshad 氏研究之土壤化育土層區分理論，供試之花嶼粘土剖面可區分爲：第一、二層稱爲積聚層，第三、四層稱爲分解層，第五層稱爲母質層，全剖面之主副層次，可排列依其順序爲 B_2，B_1，A_{12}，A_{11} 及 C 層 ，查與 Harrassowitz 氏研究磚紅土之分層理論，亦至符合，花嶼粘土當不屬於磚紅土 Laterite，惟屬相當化育良好之紅棕壤，可無疑義。

六、摘　　要

1. 本研究選取花嶼系代表剖面——花嶼粘土從新分爲五層，進行粘土礦物成分及數項理化性質之補充分析，以爲該系土壤化育之研究。

2. 粘粒部份 ($<2\mu$) 分析結果，用以鑑別及定量粘土礦物者計有：X-Ray 照片分析，示熱差分析，熱重量分析，陽離子交換能量，游離鐵及氧化鉀之含量等。

3. 分析結果發見花嶼系粘土全土體各層之主要粘土礦物成分爲 Kaolinite 約 60 %，次要成分爲 Muscovite19—25%，Fe_2O_3 爲 9—11.4%，其第一、二層並含有約 3 %左右之 Gibbsite。

4. 花嶼粘土之剖面形態及礦物成分與夏威夷之低腐殖紅壤有別，由該粘土所含之 Kaolinite 在60%左右，表層且有 Gibbsite 之存在，其紅壤化非屬初期，如與臺灣其他紅棕壤相比，則紅壤化作用尤有過之。

5. 應用 Barshad 氏研究土壤化育區分土層方法，根據物理性之補充分析結果及礦物成分，至易將該花嶼粘土剖面分別其第一、二層爲積聚層，第三、四層爲分解層，第五層爲母質層，並可排列其全剖面層次順序爲 B_2，B_1，A_{12}，A_{11} 及 C 層 ，證之 Harrassowitz 氏研究標準磚紅土之分層理論至爲符合，故花嶼粘土應屬於化育相當良好之紅棕壤。

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SOIL DEVELOPMENT STUDY OF THE REDDISH BROWN LATERITIC SOILS IN PENGHU HSIEN, TAIWAN, CHINA

by

K. W. LEUNG and C. Y. LAI

SUMMARY

1. This is a clay mineral study of Hwayu clay (representative soil series) by sampling 5 lazers of the original undisturbed soil monolith, and to analysis several supplemental items of their physical and chemical properties in order to study its soil development.

2. Data from X-Ray photographies, differential thermal analysis, thermal gravimetric analysis, cation exchange capacity, free iron oxide and potash were used to characterize quantitatively the minerals in the clay fractions ($<2\mu$) of Hwayu clay profile.

3. Kaolinite was identified in substantial amounts about 60% of all lazers, other minerals include muscovite 19–25%, Fe_2O_3 9–11.5% and about 3% of gibbsite in the first or second lazer of the profile.

4. The Hwayu clay is different from the soils of Low Humic Latosols is Hawaii base on the analytical results of their morphology and clay minerals. The soils of Hwayu clay is not in the young stage of Laterization according to the content of Kaolinite and Gibbsite and is stronger than that of the other Reddish Brown Lateritic Soils in Taiwan, if we compare their Laterization.

5. It is easily to stratified the first and second lazers as accumulated horizon, the third and forth lazers as decomposed horizon, and the fifth lazer as C horizon by using Barshad's soil development study method base on the results of the supplemontal physical analysis and conform with clay mineral analysis. So it may be arrange the five lazers in order as B_2, B_1, A_{12}, A_{11} and C also. It conforms Harrassowitze's theory which distinguishes the strata of typical Laterite. Therefore, the Hwayu clay should be classified as a rather good developed Reddish Brown Lateritic Soils.

幾種殺菌劑對薄荷白粉病防除之效果

吳 福 壽

一、緒 言

本省薄荷栽培事業年來由於農藝學者之研究及有關當局之倡導，栽培面積已逐漸擴大，據臺灣省政府農林廳[10] (1963) 報告，至民國51年已擴展至 6,889.30 公頃，其製油數量達 631,737 公斤，油價值爲新臺幣 93,821,970 元，爲配合此項工作，筆者曾從事薄荷病害調查，經獲悉若干病害普遍發生，蒙受損失甚鉅。據田間觀察，白粉病（病原菌爲 *Erysiphe cichoracearum* DC.）在多油高腦之優良薄荷而言，似僅次於銹病之劇烈病害，在各栽培時期及種圃時期，往往受其爲害，招致過早落葉，影響產量及採苗至鉅，惟至目前爲止尚乏有效對策。本試驗目的在檢討幾種殺菌劑對薄荷白粉病之防病效果。玆將所得結果列述如下，以供參考。

本試驗承蒙本所所長徐水泉博士指示與鼓勵，稿成後復蒙校閱，當試驗進行時又曾得本系黃添福先生協助，特此謹致謝忱。

二、試驗材料及方法

1. 試驗材料：

A 供試薄荷品種爲岡交1號。

B 供試殺菌劑計六種，每種各分成三種不同濃度（如表一），玆將供試藥劑種類及其有效成分列於下表：

供 試 藥 劑 一 覽 表

A list of fungicides tested and their ingredients

藥劑種類 Fungicides	有效成分 Active ingredients	製造廠 Manufacturer
Dithane Z-78	75% Zinc ethylene bisdithiocarbamate	美國 Rohm & Haas Co.
Dithane M-22	80% Manganese ethylene bisdithiocarbamate	美國 Rohm & Haas Co.
Dithane S-31	53% Maneb (Manganese ethylene bisdithiocarbamate)	
	19% Nickel sulphate, anydrous	美國 Rohm & Haas Co.
Suzu Tablet	20% Tri phenyl tin acetate	日本北興化學工業公司
KB-90	90% Basic copper sulphate (Cu 48%)	日本三共公司農藥部
Ruston	11% Nickel compounds	日本北興化學工業公司

註：撒佈藥劑量：每公頃800-1,200公升

Note: Fungicide spraying:800-1,200 l/ha

2. 試驗方法：

本試驗田間採取隨機區組法，4重複，每小區面積爲 4×2.5 公尺 ($10m^2$)，每一小區一處理（包括一種藥劑，一種濃度），各種植8行，田間管理與常法相同。

藥劑撒佈在薄荷栽植後長至約15公分高時開始，每隔10日撒佈一次，計撒佈三次，另設無撒佈區爲對照，藥劑撒佈量每公頃800-1,200公升。

病害調查在藥劑撒佈完成後，防病效果顯明時進行，每小區中間4行調查發病株率，同時取其20株，據其發病情形分成被害狀況等級11級。其標準如下：

0……………無病葉	6……………落葉約佔10%
1……………時能見及病葉者	7……………落葉約佔30%
2……………病葉約佔30%	8……………落葉約佔50%
3……………病葉約佔50%	9……………落葉約佔70%
4……………病葉約佔80%	10……………落葉約佔90%
5……………時能見及病葉落下者	

然後據下列公式求其被害程度：

$$被害程度=\frac{0A^*+1B+2C+3D+4E+5F+6G+7H+8I+9J+10K}{N}$$

* A.B.C.…………等係示該被害狀況等級別之株數

N………………調查總株數

藥害調查，當調查病害狀況時，同時調查藥斑之有否，據如下之標準記載：

－……………無藥斑	＋……………各分枝之1～2葉生有藥班者
±……………時能見及藥班者	＃……………各分枝之3～4葉生有藥班者

生長狀況調查，在各處理薄荷收割之前進行。

三、試 驗 結 果

本試驗於民國52年2月18日栽植，因久乾旱無雨生長徐緩，第一次施藥於4月9日（栽植後第50天），第二次施藥於4月19日（栽植後第60天），第三次施藥於4月29日(栽植後第70天），於5月21日開始調查發病程度。生長稍不齊。其結果如下列數表及圖：

表一 各殺菌劑之防治效果

Table 1: The effectiveness of various fungicides for the control of powdery mildew of mint.

藥劑種類 Fungicides	藥劑濃度 Concentration	發病調查 Disease investigated			藥害 Phyto-toxicity
		發病株率 Percentage of infected plant (%)	被害程度* Degree of disease infected	防治率 Percentage of disease control (%)	
Dithane Z-78	1/ 200	100.00	5.40	13	－
	1/ 400	100.00	5.69	8	－
	1/ 600	100.00	5.30	15	－
Dithane M-22	1/ 200	72.50	0.88	86	－
	1/ 400	95.00	2.79	55	－
	1/ 600	100.00	2.76	55	－
Dithane S-31	1/ 200	97.50	2.49	60	±
	1/ 400	100.00	3.15	49	±
	1/ 600	100.00	4.87	21	±
Suzu Tablet	1/ 500	100.00	4.15	33	±
	1/ 750	100.00	5.30	15	±
	1/ 1,000	100.00	5.73	8	±
KB-90	1/ 250	100.00	6.25	-1	－
	1/ 300	100.00	5.88	5	－
	1/ 400	100.00	6.03	3	－

Ruston	1/ 500	100.00	5.83	6	—
	1/ 750	100.00	6.40	3	—
	1/ 1,000	100.00	6.20	0	—
CK		100.00	6.20	0	—

* 四重複之平均數

* Averages for 4 replicates of 20 plants per treatment

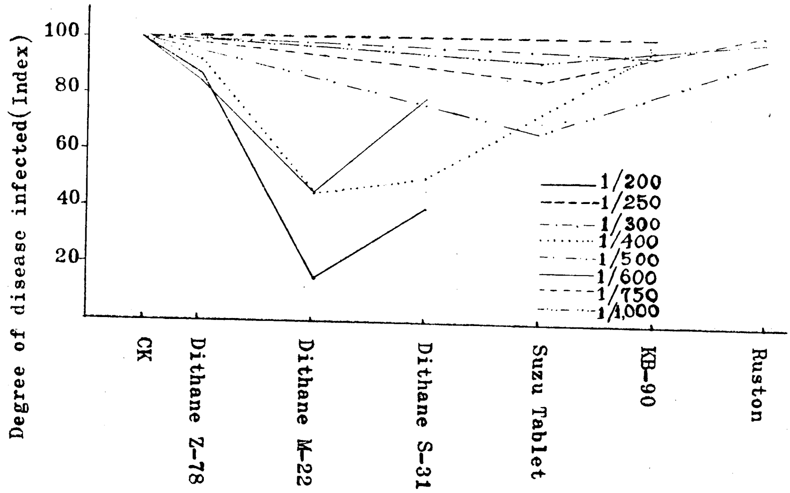
表二 變 方 分 析 表

Table 2: Analysis of Variance.

變異原因 Source of Variation	自由度 D.f.	平方和 Sum of Square	均方 Mean Square	F 値 F-Value	Snedecor's F Value	
					5% F	1 %
區集 Block	3	20.14357	6.71452			
處理 Treatment	18	218.38189	12.13233	22.56338**	1.72	2.15
殺菌劑之施用與否 Sprayed or unsprayed	1	39.13176	39.13176	72.77619**	3.98	7.01
殺菌劑之間 Among the fungicides tested	17	179.25013	10.54413	19.60969**	1.79	2.28
機差 Error	74	39.78988	0.53770			
總計 Total	95	278.31534				

** 極顯著

** Significant at 0.01 level



圖一 各殺菌劑之防治效果

Fig. 1: The effectiveness of various fungicides for the control of powdery mildew of mint.

表三　藥劑種類與發病程度之差異比較

Table 3 : The comparative difference between fungicides and degree of disease infected.

藥劑種類 Fungicides	平均發病程度 Average degree infected	差異 Differences				
Ruston	6.1375					
KB-90	6.0500	0.0875				
Dithane Z-78	5.4625	0.6750*	0.5875			
Suzu Tablet	5.0583	1.0792**	0.9917**	0.4042		
Dithane S-31	3.5033	2.6342**	2.5467**	1.9592**	1.5550**	
Dithane M-22	2.1416	3.9959**	3.9084**	3.3209**	2.9167**	1.3617**

P＝1%時之差異顯著標準值爲0.7926

Highly significant, at 0.01 level, value is 0.7926

P＝5%時之差異顯著標準值爲0.5969

Significant, at 0.05 level, value is 0.5969

表四　藥劑濃度與發病程度之差異比較

Table 4 : The comparative difference between the concentration of fungicides and degree of disease infected.

處理 Treatment	平均發病程度 Average degree infected	差異 Differences						
CK (無撒佈)	6.2000							
Dithane S-31 1/600	4.8725	1.3275**						
Suzu Tablet 1/500	4.1500	2.0500**	0.7225**					
Dithane S-31 1/400	3.1500	3.0500**	1.7225**	1.0000**				
Dithane M-22 1/400	2.7875	3.4125**	2.0850**	1.3625**	0.3625			
Dithane M-22 1/600	2.7625	3.4375**	2.1100**	1.3875**	0.3875	0.0250		
Dithane S-31 1/200	2.4875	3.7125**	2.3850**	1.6625**	0.6625**	0.3000	0.2750	
Dithane M-22 1/200	0.8750	5.3250**	3.9975**	8.2750**	2.2750**	1.9125**	1.8875**	1.6125**

P＝1%時之差異顯著標準值爲0.5606

Highly significant, at 0.01 level, value is 0.5606

P＝5%時之差異顯著標準值爲0.4221

Significant, at 0.05 level, value is 0.4221

表三及表四，1%時之差異顯著標準值以**示之；5%時之差異顯著標準值以*示之

In table 3. and 4. figures significant at 1% level marked with a double asterisk, those significant at the 5% level with a single asterisk.

四、討　　論

本試驗於栽植後，因久乾旱無雨生長徐緩，於植後第50天始行第一次施藥，供試各種殺菌劑經施藥後除 Dithane S-31, Suzu Tablet 兩種撒佈區，在葉上時能見及深褐色圓形小藥斑者外，其餘藥劑均無藥斑之發生。

據表（二、三、四）所示，在田間藥劑撒佈試驗之結果，並加以分析，藉以檢討各種藥劑間之差異，供試六種殺菌劑對薄荷白粉病，就藥劑種類而言，則以 Dithane M-22 之效果最著，在任

何濃度標準，其發病程度均較無撒佈區降低一半以上，尤其1：200稀釋液撒佈區不祗罹病株率較低，且其被害程度與無撒佈區相較差異頗大，即無撒佈區之被害程度爲100時，撒佈區却僅有14而已，實有凌駕其餘藥劑之勢，其餘各藥劑均較無撒佈者爲佳， Dithane S-31次 之，Suzu Tablet 又次之，惟此兩種均稍有誘致藥害之缺點，其濃度前者降低至1：600，後者降低至1：1,000時仍有藥害，Dithane Z-78 再次之，KB-90, Ruston 等之效果最差。

就各藥劑濃度間之差異而言，擇其最有效之兩種藥劑並加入 Suzu Tablet 1：500之一種，分析比較結果，據表（四）即可知，所列之任何一種藥劑濃度，較無撒佈者均有極顯著之差異，Dithane M-22 之 1：200 稀釋液與各藥劑濃度間之差異呈極顯著，Dithane S-31 之1：200 稀釋液與 Dithane M-22 之 1：600；1：400 稀釋液等， Dithane M-22 之 1：600 稀釋液與其 1：400 及 Dithane S-31 之1：400稀釋液等， Dithane M-22 之1：400 稀釋液與 Dithane S-31 之 1：400 稀釋液之間並無顯著差別外，Suzu Tablet 之 1：500 稀釋液，Dithane S-31 之 1：600 稀釋液與無撒佈者相較，雖不若 Dithane M-22，惟仍有極顯著之效果。

總而言之，供試藥劑中以 Dithane M-22 對薄荷白粉病之防治效果最爲卓著，在實際上應用時，當以 Dithane M-22 之 1：200 稀釋液最爲可取。

至於各藥劑對產量之影響，仍待進一步之研究。

五、摘　　要

本試驗係檢討數種殺菌劑對薄荷白粉病之防治效果，本年度曾供試六種殺菌劑，所得之結果概述如下：

1. 在白粉病發生之地，薄荷因藥劑之撒佈與無撒佈之間，其差異極顯著。
2. 供試之六種殺菌劑，大體言之均有防病效果，惟 Dithane S-31, Suzu Tablet 兩種均稍有誘致藥害之缺點。
3. 供試藥劑中防病效果最卓著者爲 Dithane M-22 之 1：200 稀釋液，其他藥劑間之差異極爲顯著，但除 KB-90, Ruston 等之效果較差外，均較無撒佈區爲佳。
4. 在實際上應用時，當以 Dithane M-22 之 1：200 稀釋液最爲可取。
5. 各藥劑對產量之影響，仍待進一步之研究。

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THE EFFECTIVENESS OF CERTAIN FUNGICIDES FOR THE CONTROL OF MINT POWDERY MILDEW (*ERYSIPHE CICHORACEARUM* DC.)

by

F. S. Wu

SUMMARY

The mint powdery mildew was a destructive disease next to mint rust, found in many fields of the mint growing areas in this Island. This experiment was aimed to clarify the effectiveness of six fungicides for control of the mint powdery mildew. Six fungicides, namely, Dithane Z-78, Dithane M-22, Dithane S-31, Suzu Tablet, KB-90, and Ruston, were tested in this experiment. The fungicides were sprayed before the disease infected. The results of the experiment were shown as follows:

1. There were highly significant differences between the fungicides sprayed and unsprayed areas of the mint field where the powdery mildew was infected.
2. The six fungicides tested, gave more or less effectiveness for control of the disease, however, Dithane S-31 and Suzu Tablet caused slight phytotoxic to the leaves after application.
3. The best disease control was obtained with Dithane M-22 at the concentration of 1:200. There were highly significant differences among the rest of the fungicides, except KB-90 and Ruston gave some effectiveness in controlling the disease.
4. Practically, Dithane M-22 (1:200) was adaptable for control of mint powdery mildew.
5. The effect of the fungicides on the yield of the mint, need more advanced study.

MODE OF RESIDUAL ACTION OF PARATHION AND ENDRIN ON THE NEWLY HATCHED LARVAE OF THE PADDY BORER, *TRYPORYZA INCERTULAS*, WITH A SPECIAL REFERENCE TO SOME PROBLEMS RESPONSIBLE FOR INCONSISTENT CONTROL OF THE LARVAE BY FOLIAR SPRAYS[1]

By

S. Y. LEE and W. Y. HONG

Although parathion and endrin have long been used for the paddy borer control in Taiwan, little information has been published concerning how residues of these chemicals effectively act upon the newly hatched larvae. In order to clarify this problem the authors conducted the following studies.

In the first place, mode of gaining entrance in the paddy plants by the newly hatched larvae was investigated. Such observations were previously made briefly by Shiraki (1917). Liang (1956) also reported that on seedlings, 68 per cent of the newly hatched larvae made entrance holes on the outside of the leaf sheaths and 32 per cent entered the plants through the openings in the top of the leaf sheaths on the plants 30 days after transplanting, 34 per cent made entrance holes and 66 per cent crawled inside through the leaf sheath openings; on the plants 60 days after transplanting, 25 per cent bored entrance holes, and 75 per cent found their way into the plants through the leaf sheath openings. The results of the present test conducted by the authors agree in general with those shown by Liang. Table 1 summarizes the data, which show that on young plants very roughly about 50 per cent of the larvae bore entrance holes to get inside. Time required for completing boring a hole varied from about 5 to 20 minutes, depending on age of the plants. On older plants, however, the majority of the larvae did not make entrance holes, but tried to find some openings on the plants through which they could readily reach a sheltered area to bore into the tissue for feeding. Such openings are usually found at the top of the leaf sheaths (Plate I, Fig. 2). After getting behind the leaf sheaths, some larvae (15 to 53 per cent) were found to bore first into the outer leaf sheaths for feeding, but usually all of them reach the center of the straw in a day or so, then feed downward to the base, causing the central leaves to wither.

It is clear from the foregoings that mechanisms by which the residues of endrin or parathion applied as a foliar spray may act on the invading newly hatched larvae are: 1) contact poisoning or fumigation with the toxicant present on the surfaces of the plants, 2) stomach poisoning due to ingestion of the plant tissue in

(1) This work was supported by grants from the National Council on Science Development and the Joint Commission on Rural Reconstruction.

Table 1. Mode of reaching inside the paddy plants in different stages of development by the newly hatched paddy borer larvae, *Tryporyza incertulas*

Date Examined	Age of Plants After Trans-planting (Days)	No. Of Insects Tested	Per Cent Of Larvae Reached Inside The Plants By Route Shown	
			Entrance Hole	Leaf Sheath Openings
Oct. 24 1961	35	64	56	44
May 17 1962	57	40	43	57(e)
Sept. 22 1961	65(a)	36	21	79(f)
	65(b)	37	11	89(g)
	65(c)	20	0	100(h)
	65(d)	37	16	84(i)

(*a*) Ears were not yet formed within the straws.
(*b*) Ears were formed inside the straws.
(*c*) Ears partly emerged in the air.
(*d*) Ears completely emerged in the air.
(*e*) Of these larvae, 53 per cent first fed in the outer leaf sheaths, and 47 per cent in the inner leaf sheaths. In either case, they reached the center of the straw in a day or two and a withering central leaf was produced.
(*f*) Of these, 20 per cent first ate the outer leaf sheaths and 80 per cent fed in the inner leaf sheaths.
(*g*) Of these larvae, 15 per cent first fed in the outer leaf sheaths and 85 per cent in the inner leaf sheaths.
(*h*) All quickly entered the plants through the opening in the top of the flag leaf sheaths that surrounded the partly emerged panicles (Plate I, Fig. 3), and most of them bored into the glumes, feeding on the stamen etc.
(*i*) The larvae crawled into the plants under the margin of the flag leaf sheath that enveloped the axis of the panicle (Plate I, Fig. 4). Most of them appeared to feed on the panicle after getting inside.

which the toxicant penetrates or translocated, or 3) combined action of the both.

To settle this question, four tests were conducted. Paddy plants used were planted in pots, 56-day-old after transplanting. Their outer leaf sheaths that were coming off the straw were removed before the treatment, so as to prevent the test larvae from quickly crawling inside. The chemicals were emulsifiable concentrates, applied at a 0.05 per cent concentration with a hand sprayer, care being taken that through coverage could be obtained. In test one, spraying was made on May 16, 1962. The test larvae were released 40 hours later, and kept crawling on the plants for about 30 to 50 minutes, then removed to untreated fresh plants for feeding. The mortality of the larvae was investigated 3 days after treatment. In test two, sprays were applied on June 1, 1962. The larvae were released 23 hours later, and kept crawling on the plants for about 30 to 50 minutes, then transferred to fresh untreated plants for feeding. The larvae were examined 3 days later, the data of these tests are summariszed in Table 2, which show that the surface residue of endrin did not kill the larvae by contact with the legs or by fumigation when released 40 or 23 hours after spraying, but the surface residue of parathion appeared to have a slight toxic effect upon the larvae. However, whether this was due to fumigation or contact poisoning was not clear. These data show that practically

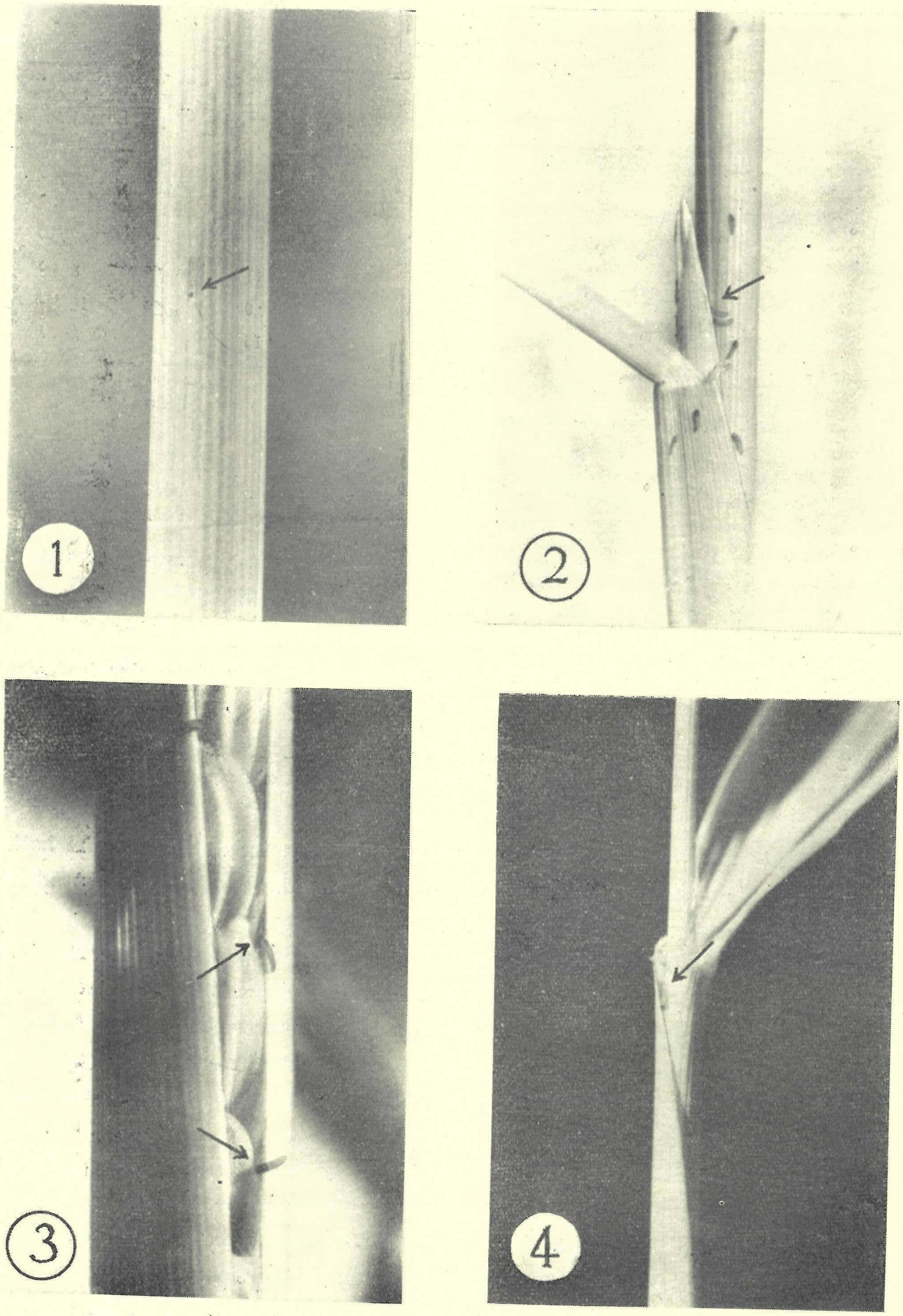

PLATE I

Tillers of paddy at different stages of development, showing various entrances of the newly hatched larvae of the paddy borer: Fig. 1. Entrance hole bored on a young straw; Fig. 2. Opening on the top of the leaf sheath; Fig. 3. Open flag leaf sheath at heading stage; Fig. 4. Loose top of the flag leaf sheath of completely headed plant.

Table 2. Toxicity of surface residues of endrin and parathion against the newly hatched paddy borer larvae kept crawling for 30 to 50 minutes on the plants 40 or 23 hours after spraying. May-June, 1962

Treatment (0.05%)	Per Cent Mortality Of The Larvae, And (No. Of Larvae Tested)	
	Test one[a]	Test two[b]
Untreated	0 (34)	0 (7)
Endrin	0 (43)	0 (7)
Parathion	9.6 (52)	11 (9)

(*a*) Larvae released 40 hours after spraying.
(*b*) Larvae released 23 hours after spraying.

residual kill of the newly hatched larvae was not due to the surface residues of these chemicals.

Test three and four were conducted to study fate of the larvae that crawled mostly through the top of the leaf sheath into the treated plant. The plants used were the same as those used in the above tests. In test three, sprays were applied on May 16, 1962. The larvae were released 40 hours after spraying, and were examined 3 days later. From 5 tillers treated with parathion, 46 larvae were recovered; all were killed, 91 per cent of them was found in the tissue of the leaf sheaths and 9 per cent between the outermost and the second leaf sheaths. In 4 tillers sprayed with endrin, 45 larvae were recovered, of which 82 per cent was killed in the tissue of the leaf sheaths, 9 per cent between the outermost and the second leaf sheaths, and 9 per cent feeding normally in the tissue of the leaf sheaths (mortality 91 per cent). From 3 untreated tillers 36 larvae were recovered; all feeding normally in the tissue of the leaf sheaths. The results of this test and the data of Table 2 suggest that residual effect of parathion and endrin might be due primarily to stomach poisoning of the larvae by the feeding in the leaf sheaths into which the toxicants were translocated. Another test was replicated using similar methods and materials as above, except that no adjustment was made on the plants, that is, the loose outer leaf sheaths were left as they were. Sprays were applied on June 1, when the plants were 72-day-old, and the larvae were released 42 hours after spraying. The results were examined 13 days later, and are shown in Table 3.

It is not quite clear from the data of Table 3 whether or not the larvae were killed mainly by stomach poisoning. However, it is clear from these data and data of Table 2 that residual effect of endrin and parathion is due to the penetration residues, not to the surface residues.

Here, considerations should be made on several problems that make presence of sufficient amount of penetration residue in the paddy plants difficult when applied as foliar sprays. Firstly, deposits of the toxicant on the lower part of the tiller where the insects attack is prevented by dense growths of the leaves beyond one or two month-period after transplanting, when sprays are applied from their top. When

Table 3. Residual toxicity of endrin and parathion on the newly hatched paddy borer larvae crawled into the plants through the opening at the top of the leaf sheaths. June, 1962

Treatment (0.05%)	Per Cent Mortality Of Larvae And (Total No. Recovered)	Per Cent Mortality Of Larvae Recovered From Leaf Sheaths Shown		Per Cent Distribution Of The Dead Larvae Recovered At Varying Distances From The Entrance (Mm. Downward The Straw)		
		Outermost	Inner	1-5	5-10	Below 10
Untreated	0 (25)[a]	—	—	—	—	—
Parathion	100 (36)[b]	78	22	80	13	7
Endrin	56 (16)[c]	67	33	33	56	11

(*a*) Most of the larvae were feeding in the center of the straw.
(*b*) Six larvae went 1 mm. upward the straw and were killed.
(*c*) None went upward the straw. The 7 living larvae were all in the center of the straw.

the nozzle is inserted between the rows of the plants and sprayed sideways, better deposits on the straws can be obtained, however it is still difficult to cover the tillers in the center of a hill. Even if good coverage were possible, it would yet be difficult to have uniform or regular translocation of the toxicant into the inner part of a tiller since the tiller is not one-bodied in the aerial part, but consists of a group of separate leaves that are connected only at the base, which in younger plants is under the soil, or at the nodes on older plants whose stems appear above the ground. In fact, the data of a test to investigate residual effect of endrin and parathion applied as foliar sprays under field conditions in two ways on 2-month-old plants of the first crop show that little residual effect is obtained with these compounds when applied from the top of the plants at the standard rate of 1,200 liters per hectare. When applied sideways, parathion showed much better results, but endrin was still poor at the standard rate of application, and gave only some effect at a double dosage. The data of this test are shown in Table 4.

Table 4. Comparative residual effect of endrin and parathion against the newly hatched paddy borer when applied from the top and the side of the plant (test insect released 3 or 4 days after spraying). May, 1962

Treatment (0.05%)	Dosage l./hec.	Direction Of Spraying	No. Of Tillers Whose Tips Withered/Total Examined (Four Replicates)			
Untreated			19/43	24/47	13/48	19/47
Endrin	1,200	Top	26/51	13/44	14/48	11/52
Endrin	1,200	Side	12/59	12/51	10/52	11/50
Endrin	2,400	Side	3/38	8/49	8/50	5/46
Parathion	1,200	Top	18/43	13/53	16/45	15/49
Parathion	1,200	Side	0/54	3/52	0/63	0/47

Although no test was made on initial effect, it is clear from these data that consistent control of the larvae is difficult with foliar sprays at the normal rate of 1,200 liters per hectare applied from the top of the plants with a knapsack sprayer.

Residual control with various foliar sprays becomes particularly poor on the plants whose ears are still partly enclosed by the flag leaf sheath. (Lee and Hong 1963) As already mentioned, on such plants the larvae very quickly crawl into the plant through the open flag leaf sheath and feed in the glumes or in the axis of the ear in which little or nonlethal amount of the toxicant may be translocated by a foliar application. Therefore, to secure better control of the larvae, studies on other methods of treatment or efficiency of other spraying equipments must be conducted.

It is interesting to note here, however, that in spite of this fact, in some field tests (Liang and Liu 1958; Tao 1958 a, b; 1963) significant increase in yield or reduction of white ears over the control plots has been obtained with endrin or parathion treatment. In these tests no investigation was made on how the borers were destroyed by the treatments, and the effect was determined only by increase in yields or, in addition, by reduction of white or dead ears, which could be also caused by some other insects. As is found in some of the tests conducted by Tao et al. (1963 a, b) increase in yields was not always in accordance with reduction of the white ears. This suggests that the effect might have been due to control of some other insects or diseases. It was neither clear in these tests whether decrease of white ears, presuming they were all caused by the paddy borer, was due to destruction of the larvae, or moths or eggs. Such considerations become important since pot screening of insecticides in Taiwan has usually been conducted against the larvae feeding within the plants and those hatching after treatment. Certainly the larvae can thus be killed when every tiller in a hill is throughly covered with the spray. However, as already pointed out kill of the larvae in the plants two months after transplanting or at the heading stage (Lee and Hong 1963) can not be expected by foliar sprays when applied from the top of the plants at the normal rate.

It is therefore questionable that in many field tests where significant results were obtained, the effect of endrin, parathion or some other treatments was due to kill of the larvae feeding within the plants or hatching later on. These treatments might have been acting on the eggs; or on the moths that were either destroyed or merely repelled. Although such repellent action of endrin or parathion is questionable, it should be considered that if their effect were due to repellent action, the moths would then concentrate on the control plots and thus make the results of the control look abnormally phenomenal. It is obvious therefore that when the mode of action of certain treatment is not clear its evaluation should not be made just on basis of relative results obtained in the treated plots and in the control, but it should be finally studied in the field where no control plot is used.

Kill of the invading larvae by direct hit with foliar sprays does not seem great as time period during which the newly hatched larvae or the migrating larvae remain outside the plants is but a fraction of their life.

At any rate, it is clear from these results that detailed field studies should be conducted to investigate what stages of the insect are being mainly controlled by

foliar sprays under certain conditions of the plants, so that more correct laboratory screening of insecticides can be made by using appropriate stages of the borer as test insects.

SUMMARY

Studies were made to investigate how residues of parathion and endrin acted on the invading newly hatched larvae of the paddy borer, *Tryporyza incertulas* under laboratory conditions. The results obtained show that practically residual kill of the larvae is not due to the surfaces residues, but to the penetration residues of these chemicals.

Discussions were made on the difficulties to secure sufficient amount of penetration residues in paddy plants by a foliar application of sprays, and also on possible mode of action of these chemicals upon the insect under field conditions.

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Parathion 及 Endrin 對一點螟蛾初孵幼蟲之殘留作用程序，特別關於莖葉噴射液劑對幼蟲防治無常效之若干問題之討論

李 淳 陽　　洪 文 堯

摘　　要

本研究旨在觀察室內條件下 parathion 及 endrin 之殘毒對爲害之一點螟蛾初孵幼蟲如何作用。於所獲結果中示出對該幼蟲之實際殘效並非由於表面殘毒，乃在於該等藥劑之滲透殘毒。

以莖葉施藥法使用之噴射液劑使稻株中獲得足量滲透殘毒之困難及該等藥劑對田間條件下之該蟲之可能作用程序於本文中均曾作討論。

文 獻 介 紹

ABSTRACTS OF LITERATURE

一、稻屬內種間什交之胚培養[Iyer R. D. & O. P. Govila (1964) The Indian Jour. Genetics & Plant Breeding 24 (2):116～121]

植物胚培養爲 Hannig氏 (1904) 首先試驗成功，但 Laibach (1925, 1929) 始在百合科植物之種間什交時克服了什交不親合性 (Incomypatibility)。稻屬則到 Niles (1951) 始應用之。利用 Sativa, officinalis, australiensis 等種內和種間什交 30 條組合。什交後之 Caryopsis 取出，用新準備之冷飽和 Calcium hypochlorite 溶液行表面殺菌。柔軟種子在溶液中攪動15分鐘，稍硬或成熟的種子則處理30分鐘。然後用玻璃蒸餾器之蒸餾水洗三次，並浸於此種蒸餾水中12—16小時，放於無菌室中。其後在無菌情況下之解剖立體顯微鏡下取出胚。

培養基使用 White氏 (1943) 之基本培養基加 0.1 %麥芽汁 (Difco) 和 10 %椰汁 (Coconut milk)。同時也應用 Nitsch 氏 (1951) 之基本培養基加 10 %之椰汁。同時兩者均加2%之蔗糖 (Sucrose)。鐵分則由 Feric tartrate 供給。培養基測定至 PH6.0 後加0.7 %之 Difco's bacto agar 使之凝固呈膠體狀。

培養進行於溫度控制室中 (25±1°c)，先爲黑暗中，後在螢光燈 (Fluorescent lamp) 100—110呎燭光下連續照射 2 天。幼苗由試管取出後洗去洋菜 (Agar)，保存在 Karim 和 Vlamis (1962) 建議之營養液中10—12天。然後栽種於溫度控制玻璃室內之試砵 (Pot) 中。

13組合種間什交(Intersectioral crosses) 和14組合種內什交 (Intrasectioral crosses)，利用上法由胚培養至成熟。在 4 種什交內，子房培養 (Ovary culture) 亦被利用。結果 14 個培養體中，9 株發芽，6 株培育成植株。在所有上述什交組合之由胚或子房培養成之幼苗，均在培養皿中充滿自來水之濾紙上使之硬化。由於自洋菜培養基培養後移植於試砵中之死亡率很高，乃改用液體培養，結果成活率可達 100 %，稍成熟之胚對上述兩種培養基反應相同。但幼小之胚，似以 Nitsch 培養基含10%椰汁者較佳。(嚴盛添)

二、水稻內外穎上谷毛之遺傳 [Richharia R. H. & R. Seetharaman (1964) The Indian Jour. of Genetics & Plant Breeding 24(1):84～88]

利用三種親本，Gs.215—美國種，長粒，中熟，無毛 (Glabrous)；Gs.513—埃及種，中長粒，短硬谷毛 (Short, stiff hairs)；Ac.1778—Orissa 種，稍長粒，細毛 (Fuzzy) 規則分佈於內外穎表面。

Gs.215×Gs513，其 F_1 有谷毛。F_2分離爲 86 有毛：27 無毛，合於 3：1，其適合度爲 $X^2=0.0737$；$P=0.80$——0.70。F_2 中 8 株屬谷粒無毛者，自交後仍爲無毛；15株有谷毛之植株中，8 株自交仍有谷毛，而其中 7 株則又分離爲 3 有谷毛：1 無谷毛。同時也注意到，谷粒無毛者，葉片亦光滑無毛。

Gs.513× Ac.1778，其 F_1 和父本 Ac.1778 相同，谷粒表面有長谷毛。F_2 分離 183 細毛 (Fuzzy)：63毛狀 (Hairy) 很適合於 3 細毛：1 毛狀 ($X^2=0.813$；$P=0.50$—0.30) 之分離比。F_2 中，5 系統具有毛狀谷毛者 (Hairy) 自交後代全與上代相同；21系統具有細毛中，7 系統自交乃產生細毛；14系統保持 3 細毛：1 毛狀谷毛之分離比，且非常符合。

Gs.215× Ac.1778。其F_1谷粒上，有細毛，但其密度較前組合小。F_2 則分離成 76 細毛 (Fuzzy)：28毛狀(Hairy)：30無毛(Glabrous)，此結果很適合於9：3：4之比例 ($X^2=0.6998$；$P=0.80$—0.70)。F_2 中，4 系統無毛者，自

交後代均無毛；10系統具毛狀谷毛者，自交後，2系統仍為毛狀谷毛，另8系統則又分離成3毛狀：1無毛 ($X^2=0.79$；$P=0.50$—0.30)；16系統具有細毛谷毛者之 F_2 植株，自交至 F_3 代內，分離成；均產生細毛者，3細毛：1毛狀、3細毛：1無毛、9細毛：3毛狀：4無毛等四情形，其比例為 1：2：2：4 ($X^2=5.37$；$P=0.20$—0.10) 這些系統在 F_3 代內之表現，證實了 F^2 代內之分離本質為正確。

谷毛之遺傳因子為 Gl (Jodon et al 1963)。由 Gs.215×Ac. 1778 什交後代中，推測出細毛谷毛 (Fuzzy) 受顯性因子 Fg 支配，而 Fg 對 Gl 有上位性 (Epistatc)。由此，又推論出親本之因子型如下：Gs.215—fgfgglgl；Gs.513—fgfgGlGl；Ac.1778—FgFgGlGl。（嚴盛添）

三、單元體玉米之檢定 [Coe E. H. Fr & K. R. Sarker (1964) The Jour. of Heredity LV (5):231～233]

玉米單元體 (Haploid) 植株不像雙元體 (Diploid) 那麼多。平均為千分之一或在某特殊品系中達千分之三以上。現利用 Stock 6〔CC. 子葉盤 (Scutellum) 有色高頻度單元體發生系統〕和具有 Stock 3〔低頻度單元體發生系統，C.C.子葉盤無色〕之F_1個體為母本。和具有 C^IC^I 之 Stock 3, Stock 6 和 6×3 之 F1 父本雜交。此父本是由什交第一代中選擇具有 C^I 之系統和 Stock 3,6 回交，而選出者。所使用的系統中，並無其他的標識 (Marker) 可利用。胚乳無色之種子所產生的結果，仔細地與有色子葉盤者只鑑別其子葉盤上之顏色。但顏色本身亦有許多變異。可分，極明顯的深紫色，和與無色胚乳形成極明顯之外形 (Outline)。此外亦有許多種情形，如只子葉上部之顏色極明顯；顏色淡尚可能分別者；顯示極淡，很難分別者等。另加對照區（子葉盤無色）。Coe 曾說，單元體植物能很容易地利用明顯的形態特徵 (Morphological feature) 和實際完全的雄不稔性 (Complete male sterilty) 分別，但尚無進行染色體之計算，但少數個體，證實單元體之保衛細胞(Guard cell)變小。

在35,983穗中，有264是「清楚的情形」(Clear case)，184發芽中的180證實將是單元體。四株例外者中，3株發現可能為 C^IC雙元體和或因 C^I 的失去而無法分離。第四個例外是一生育很强的，CC 雙元體和假定是母系雙元體，但由於無其他標識可資判別。在43可能的情形 (Prabable Case) 中，只21發芽，和其中16個是單元體。推定此弱的種子子葉盤部顏色是由於表現時的變異結果。在可疑的情形 (Doubtful case) 中因為發黴，發芽很少，並且單元體亦很少。對照屬子葉盤無色植殊，在田間，作產生之單元體數很少。此不能說明已有父系來源(Paternal orgin)。這很像子葉盤的因子，在母系中分離。在種子分類 (Seed classification) 時，利用顏色抑制因子 (C^I)，來判別單元體之由有色子葉盤母本 (C) 而來，是很有用的。可減少，大量操作時之勞力。此外可利用 C 花粉在 C^IC^I 母本上來鑑別父系單元體（發生率為 1/8,000）。不幸的是，可資此法利用之標識，尚未能普遍地在已試驗的材料中，尤其在栽培品系中找到。因此，此法目前只限於試驗用。（嚴盛添）

四、棉株如何生長並且生育為何變異 [W. H. Tharp (1962) World Farming 4(3):46～4(6):54]

作者 Tharp 博士為美農部之植物專家，本文專就棉生理研究新成就，作綜合性與實驗性報導。作者具有立體觀念，用簡單原則與明確詞句，刻劃出一個扼要而深刻的輪廓，介紹於大衆讀者之前。對於以往觀念大有改進。所用材料以陸地棉與埃及棉為範圍，而以前者為主。若兩者有明顯出入之處，則特加說明。玆分三部份如下：

㈠棉株生育過程上之重點：——棉子貯藏時之乾燥度（水份佔10%以下）與冷凉狀態，影響發芽率甚大。發芽出土之前，根系發育甚速；而棉苗出地面時，地下之直根系已可深達9吋。又當幼苗直立向上與子葉開始伸展時，地下之側根亦開始發育；其直根繼續急速向下生長，直至數呎而根之粗細猶未增加。根深視土深與環境而異。

在半乾旱之區，棉根可深達10呎以上，向四周外圍可達數呎。棉葉之大小厚薄受氣候與

栽培之影響甚大，葉之毛茸影響機械採收棊鉅。棉莖上每節之第一腋芽可發生葉枝亦可發生果枝，而第二腋芽必生葉枝。

㈡棉之果枝、花芽、蒴及種子：——棉之果枝係假軸性生長；果枝之可見部份，首爲第一花芽，即普通之第一蕾。花之授粉，一般均在開花當日之晨間。當花瓣張開之際，柱頭伸長而貼近雄蕊圈。只待雄蕊花粉囊開裂，花粉附着於柱頭之黏性表面，乃發生花粉管而受精。在以後50日左右，完成果實、種子、及纖維之成長。玆將數種性狀所長成之日數列如下表：

蒴之大小（長度）………18日
蒴重…………………………45日
種子大小（長度）………18日
種子重（乾）……………45日
種子油分…………………42日
種子蛋白質成分…………45日
纖維長度…………………18日
纖維强度…………………45日
纖維厚度（重）…………45日

㈢棉之生育爲何變異：——棉株生育變異，具6項因子：

1. 品種——品種對於溫度、光線、水份、營養分、栽培方法等項，均因不同性狀而具有不同反應。品種之差別點在生育環境之變異中仍顯明存留而不被淹沒。

2. 溫度——土溫形響種子發芽。氣溫最低60°F，最高102°F。以 93°F 爲最適。氣溫高則始蕾早，29日已足。蕾期25日之品種，可偏差2日。鈴期自48日至68日。氣溫高則每鈴之纖維量大，纖維粗而短，强度大，衣分高，種子輕，油份低，蛋白質成分高。棉作產量依靠蕾數，結實率，成熟鈴之數目與重量而定。落蕾落鈴百分率並不因高溫而變動。

3. 水份——棉株乾物質每磅需要水份 562磅，較馬齒種玉米約高34%。玆將各期每日所需水量（以吋爲單位）錄後：

時　期	種植後日數	每日所需水量（吋）
A. 幼苗出土至始蕾	10至15日	0.1″以下
B. 始蕾至始花	45至75日	0.1″至0.25″
C. 盛花期	75至120日	0.25″至0.4″

4. 日光——棉爲喜愛日光之作物，野生棉與蘇聯棉種爲短日性外，陸地棉與埃及棉爲中日性。久雨久暈發生大量落蕾落鈴。

5. 營養分——對於 N, P, K， 棉株之生理需要各有適量。N過量則促進第二腋芽之發育以成「徒長」。

6. 栽培方法——播種期，密度等使產量變化，其發展成爲立體觀念。某年份棉株下部結鈴狀況不良時，其積蓄之同化養分能供棉株上部結鈴增加，因而總產量仍保持正常。令人發生二層樓之立體感，亦即各年有其一定之產量，雖受意外打擊而「年歲」不致大變。（孫貽謀）

五、立枯病之研究 [T. Matsumoto, M. C. Wang, and H. J. Su (1961) Proceedings of the Second Conference of the International Organization of Citrus Virologists, Univ. of Florida Press Book 121～125]

立枯病過去認爲不宜土性如過濕及主要營養要素之缺少，可是此病之擴大年年增加，並不能因改良土壤而防止之，經著者等3年之詳細研究，爲毒素病無疑。

雖然病徵因環境及柑桔品種不同而異，但通常由健狀樹開始萎凋，變黄或葉片葉脈黄化，早落，小枝枯死，產生奇形簇花，鬚根及側根腐敗，葉片萎凋，以致整株枯死。

經用各地有病酸桔砧木之椪柑及桶柑連續的，同時的行橋接於數盆酸桔苗。也用傳病昆蟲，大桔蚜 Toxoptera citricida 作傳病試驗結果極似 Tristeza； 故第一步舉行芽或葉接於墨西哥檽檬上，證明爲 Tristeza 無疑。

但是臺灣之 Tristeza 與北美不同，而與南美者相近，經用 Aelopsis chevalieri 苗嫁接二個月後，因其亦顯示葉脈透明，葉片杯狀，及枝條有針眼。

但是本省之 Tristeza 可能爲不單純之毒素，因病毒 UO1 接種於已有病毒 YMS15 之以酸桔爲根砧之椪柑或桶柑上或相反的嫁接之，即使經過5個月後，亦不出現病徵，然若單獨接種之，則嚴重發病，反之同一植物交接

UO1 及 UO14 或 YMS15 及 UO14 不顯示一年內出現標準之病徵。由此可知，UO1及 YMS15 之間發生干擾而於 UO1、及 UO14或 YMS15 及 UO14 之間不發生干預，至目前爲止，此種干擾之機械解釋尙不明瞭，因此等系統爲單純或有一種以上之故。總之數種毒素系統如 YMS15，UO1,UO14 及 T_2 接種於 Eureba lemon 上與 Fraser 氏之試驗之反應相似。

砧木與接穗之組合反應試驗之砧木 Trifoliata, Cleopatra, Troyer citrange, Citrus junos, Citrus Tachinaba. Citrus tangerin, 椪柑接於 Cleopatra 上雖然在南北美洲接穗爲甜橙成爲耐病砧木並成爲商業上甜橙之適用根砧，但在臺灣用接椪柑，反爲毒素病之敏感根砧。反之，椪柑接於枳殼上 trifoliata 顯示較其他根砧爲耐受，此項結果枳殼根砧，橙子列爲耐受等級。

經化學試驗，酸桔砧木及酸桔砧木上之椪柑受毒素病之枝顯示無澱粉存在，而對照植物之相同部份，則有澱粉集積。反之，有病之葉除病度進行外，澱粉較多，此時葉片多少呈現健狀及淡黃色。推測被害葉之澱粉較多或爲在葉之維管束素 (foliar vascular elements) 中之韌皮 (Phloem)腐敗 (necrosis)，阻止炭水化合物之運輸。在淡黃色葉片中之澱粉減少或消失，或在死亡邊緣上以有限之光合作用產物下，澱粉之利用所成。

有病之椪柑及桶柑葉中之 Amylase 活動，除數例外，同相葉齡之健康葉片，通常較爲高，此種情形與 Tripki 及 Mesiae 氏之發現相反，此種結果或爲品種不同或爲椪柑及桶柑葉片之澱粉過分集積，因爲適應自然，加强 Amylase 之活動，亦未可知。

用 chromatography 紙指示，在毒素侵害之墨西哥檑檬葉片中之葡萄糖 (glucose) 及果糖 (fruitose) 較健株葉者爲多，而蔗糖 (sucrose) 正常，chromatography 紙也指示毒素侵害之葉中之不揮發性有機酸，雖然此種研究爲初步並仍在進展中，似乎顯示在毒素侵害桶柑及墨西哥檑檬葉中之枯橼酸 citric，苹果酸 malic 及蔗糖酸 succinic 爲減少，但是草酸 oxalic 略爲增加。

Trippi 及 Mesias 已指示在毒素侵害桶柑葉中之葉綠素AB減少而胡蘿蔔素 (carotenoids) 反而更多。

用芽接於墨西哥檑檬上之葉及枝之組織研究，發現韌皮纖維細胞在葉組織中之透明葉脈消失及韌皮素酸 Phloem elements 浸入木質部顯呈和諧。雖然葉脈及染色細胞(chromatic)透明原因，至今尙未進行說明，因爲渠等研究尙未進展至此。（陶家駒）

六、稻白葉枯病藥劑防治試驗調查標準［吉村彰治（1964）植物防疫 18 (9):367～368］

一般植物病害罹病程度之記載方法，因其病徵之不同從1954年以來略有四種重要之提案。但這些方法應用在調查藥劑防治試驗結果時，常因藥劑之殺菌效果而減輕罹病程度，致出不易在數字上看出藥劑間之差異。（日本）農林省北陸農事試驗場，爲稻白葉枯病藥劑防治試驗病害調查之需要設計以下之調查標準，其內容以上述四種方法爲原則，按照白葉枯病藥劑防治試驗之實際情形加以改良，將表示之重點移至被害輕微部份，其概要摘錄如下。

病害調査之時期均統一在水稻收割前兩星期時擧行。每小區調查40株，每株調查5—7葉，記錄方式以全葉面積中，被病斑佔有面積百分比之不同，分爲0—10 之十二種指數以十進法代表不同罹病程度。如病斑面積佔全葉面積之 3 %以下者以指數 0 表示，病斑增加到 5 %左右者以 0.5 表示，10 %左右時以 1 表示，20 %左右者以 2 表示 90 %左右者以 9 ；100%者以10表示之。本指數記妥後必再歸納成五大類以便代入公式：即 A代表指數0.5之部份，B代表指數 1 者，C 代表2—3之兩部份，D 則代表4—6之三部份，E 代表 7 以上之四部份，分妥後即代入下列公式計算罹病率。

公式：罹病率

$$= \frac{0.5A+B+2C+3D+4E}{4\times \text{調查總葉數}} \times 100$$

（杜自疆）

七、為害洋菇菌床的 *Pythium* 菌

[Fergus C. L. 等 (1963) Phytopatho. 53 (11):1360~1362]

洋菇栽培舍中病害種類雖多，但藻菌類 *Pythium* 屬爲害洋菇菌床之記載尚未見到。美國 Pennsylvania 州立大學曾在1960年間於該州商業經營之洋菇農園發現一種白色圓形大小一英尺直徑之什菌菌落，被本什菌侵害之菌落範圍內，洋菇菌種無法發芽生長，洋菇菌絲生長後再受什菌侵害者仍受其影響而無法正常發展，發生嚴重時影響洋菇產量甚鉅，但尙幸者本什菌只能深入棚架之底部而菌落面積擴大較爲緩慢，且不影響同一床上之菌落範圍外之正常洋菇之生長。

本什菌經過三年之鑑定工作方於1963年確定爲*Pythium ortotvogus*。本文對本菌之病徵有詳細記載外，關於本菌之生理生態方面仍有精細之研究以判明分類學上之地位，並附顯微鏡照片七張，明確表示本菌之形態，又在卷尾提供參考文獻六篇，證明鑑定之根據。（杜自疆）

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